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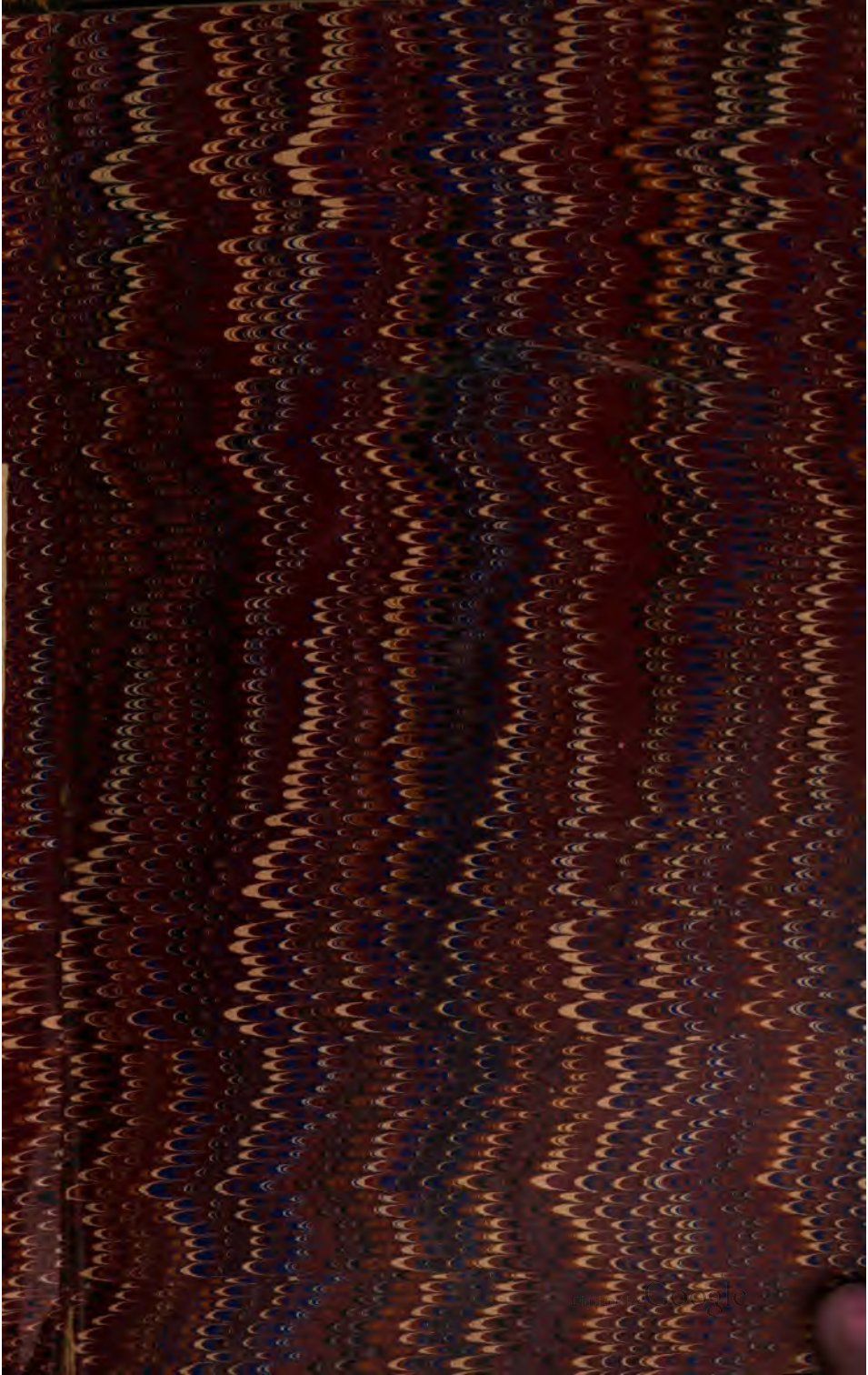

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TABLES

FOR THE

DETERMINATION OF MINERALS

BY

47697

PHYSICAL PROPERTIES

ASCERTAINABLE WITH THE AID OF A FEW FIELD INSTRUMENTS.

BASED ON THE SYSTEM OF PROF. DR. ALBIN WEISBACH.

BY

PERSIFOR FRAZER,

DOCTEUR ÈS-SCIENCES; OFFICIER DE L'INSTRUCTION PUBLIQUE; FELLOW G.S.A.; PROFESSOR OF CHEMISTRY FRANKLIN INSTITUTE AND PENNSYLVANIA HORTICULTURAL SOCIETY; CORRESPONDENT DER REICHSANSTALT ZU WIEN; VICE-PRESIDENT INTERNATIONAL GEOLOGICAL CONGRESS; HONORARY MEMBER SOCIEDAD CIENTIFICA "ANTONIO ALZATE," MEXICO; LIFE MEMBER OF THE AMERICAN PHILOSOPHICAL SOCIETY, AMERICAN INSTITUTE M. E., ACADEMY OF NATURAL SCIENCES, B.A.A.S.; LIFE FELLOW A.A.A.S., ETC., ETC.

THIRD EDITION, ENTIRELY REWRITTEN.

PHILADELPHIA:
J. B. LIPPINCOTT COMPANY.
1891.

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WHILE conducting the exercise of mineral determination in the Freiberg Academy here, I have noticed that the students, in examining the specimens given to them, often lose much time in looking out and reading the descriptions in the various compendiums of minerals; and this originated in me the desire to place in the hands of those taking this course a means to assist in the diagnosing of minerals; all the more from the fact that the only attempt thus far known, and which was by Dufrenoy,* to help the determination of minerals by their physical characteristics, can scarcely be said to have been a success. On the other hand, in the tables of von Kobell† and Dana,‡ the chemical behavior has been selected as the main principle of classification, the employment of which, it is true, in itself and for a single student, is very good, nevertheless in a larger class associates with itself many disadvantages when the students are not sufficiently conversant with the physiognomy of minerals.

From this cause I determined to sketch out a plan of arrangement for myself, in the main based upon the outward characteristics.

In this I have divided minerals into three tabular systems, of which the first embraces those of metallic lustre; the second those of non-metallic lustre which give a colored powder; and lastly, the third contains all minerals of non-metallic lustre and colorless streak. These three systems of tables fall again into single tables (for example, the first into five), in which the minerals are arranged according to their hardness,—*i.e.*, the softest are placed first, and the hardest last.

It follows from this, that when a given fragment of mineral is to be determined by the aid of the tables, one must first ascertain the kind of lustre, the degree of hardness, the streak, and (with metallic habit) also the color. If these characteristics are determined correctly,—and their determination is so easy,—the seeker will be confined by the tables to a small number from which the choice must be made; out of which the correct one can be found sometimes immediately, and sometimes with the assistance of a special search in a text-book of mineralogy; but almost always without difficulty, provided that the crystal system be plainly visible; if this characteristic be wanting, the determination will be more difficult, or at least more tedious, especially when the mineral belongs to the class of those with non-metallic lustre and colorless streak.

ALBIN WEISBACH, *Preface to the First Edition of his "Tabellen,"* 1866.

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* Dufrenoy, Traité de Minéralogie, 2e édit., i. 529–703.

† F. v. Kobell, Tafeln zur Bestimmung der Mineralien mittelst einfacher chemischer Versuche auf trockenem und nassem Wege.

‡ J. D. Dana, A System of Mineralogy, 4th edit., i. 261–310.

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INTRODUCTION TO THE FIRST EDITION.

(1874.)

* * * * * * * * * * *

EVERY one who has had the good fortune to study at the Royal Saxon Mining Academy, in Freiberg, will bear witness to the efficacy of the system there pursued for instructing young students in the art of distinguishing mineral species on the spot, by the aid of a tolerable memory and an intelligent observation of a few of their most striking physical properties,—both brought to the highest point of perfection of which they are capable by judicious cultivation, and kept in their best condition by assiduous daily exercise.

The method of practical instruction pursued there, and which has been introduced by Freiberg graduates into many schools in this country, requires merely a cabinet of unlabelled minerals, and a Professor who can determine—not one who has *learned*—them. Each student of a class of ten or more places a tray of such minerals before him, and occupies the two hours devoted to "Praktischer Uebung" in discovering, by the aid of the knife, the streak-tablet, the file, and the magnifying-glass, the true nature of as many of these minerals as possible.

* * * * * * * * * * *

But all will admit that no tables based upon purely physical properties can enable one to identify *all* species; though the greater one's experience in the field, the fewer minerals will require a laboratory investigation.

There are three applications for which these tables were more particularly designed: The first is in the class-room, as an artificial memory to the student practising instantaneous determination; the second is for the prospector, geologist, or mineralogist in the field, as an occasional reminder of some point which was escaping his attention, and to suggest the simplest methods of discovering the identity of minerals if the physical tests fail; and third, they may prove serviceable to him who, though neither geologist nor mineralogist, is impelled by business or love of nature to collect minerals.

In America mineralogists have very generally agreed to consider Dana's last edition as authority on most disputed questions, and in nothing does this great work more clearly show the incredible industry, care, and good judgment of its author than in the considerations which have influenced him in regard to the choice of names for minerals. He has given to this essential though less professional part of the subject so much thought, has weighed so fairly and justly the claims of rival claimants to the right of naming, and has altered objectionable names with such independence and ability, that it would be strange indeed if an American book on any branch of the subject did not make Dana's nomenclature the basis of its own. This has been done in the present tables.

Every true mineral is a definite chemical compound, or element, homogeneous throughout its parts, and capable of expression in a formula which represents—at least—the proportions in which the atoms of the same or different elements are associated together in its molecule.

Its molecule is a distinctive whole,—the unit of its mass,—and incapable of division so long as the mineral retains its characteristic properties; and any formula which repre-

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sents the mineral as consisting of two compounds is in antagonism with this fundamental principle, and can convey no clear idea of unity to the mind.

Starting with these postulates, as soon as I had decided to add a column of formulas to the tables, I determined to try, to the best of my ability, to reconcile the most reliable records of analysis with it, and if possible, in the light of the modern chemistry, to push this effort beyond mere empirical percentages to the construction of rational formulas. I frankly own at the outset my entire responsibility for all the errors into which I may have been drawn, and cheerfully grant that many of my inferences may be mistaken.

While overhauling the records of analysis which were accessible to me, to recalculate formulas whose character should express unity, I was forced in some few cases into making bold assumptions as to the manner in which the anion and cathion radicals were strung together, and it is in such formulas that I expect, and shall meekly submit to, criticism.

In the case of some silicates, * * * I have assumed that the total power of the aluminum atoms to satisfy acid radicals is diminished by so many bonds as are represented by the number of atoms of the other cathion elements present, these bonds uniting the latter as to an acid, and leaving the remainder to be in turn saturated by the acid silicon radical. I confess that this hypothesis does some violence to old accepted notions of chemical union, more particularly as the dyad thus saturating the aluminum must always itself be a stronger cathion than the latter, and therefore more likely to combine with SiO_4. These difficulties are plain, and I can only say that this arrangement agrees with the percentage composition of the minerals as derived from some of the most trustworthy records of analysis, and that I discovered no other which would.

It is necessary for this hypothesis to assume that no aluminum molecule is *completely* saturated with the base, and that none of this base is united directly to $(SiO_4)^{IV}$, for in either case there would be a splitting up of the original molecule into two others.

It is understood, of course, that what I have said as to the exclusion of the sign + from the formulas of minerals has no reference to the molecules of water, which always accompany crystallization in certain minerals; nor have I deemed it necessary to indicate this water by the symbol aq., for the reason that +6aq., or +12aq., seems inconsistent with a pure chemical notation.

Simply for convenience, and as an arbitrary method of indicating the parts I have supposed its constituents to be playing in the compound, I have adopted the plan of writing the symbol for the other bases before that of Al_2 *without* a comma when the whole of its combining power is added to that of the latter to saturate the anion radical, and *with* a comma between them when the number of atom-saturating equivalents of the bases was constant, while the proportion to each other of the bases was variable. As, for example: $(R^{II}(R_2)^{VI})(Si^{IV}O_3^{II})_4^{II}+6(H_2O)$ * * * means that an atom of a dyad base and a molecule of hexad base together satisfy four molecules of the bibasic radical, $(Si^{IV}O_3^{II})^{II}$; whereas $(R_3^{II},(R_2)^{VI})(Si^{IV}O_3^{II})_3^{II}$ implies a compound in which the six bonds of $(Si^{IV}O_3^{II})_3^{II}$ are divided in varying proportions between the dyad and hexad base; and $((R_2)^{VI}R^{II})^{IV}(Si^{IV}O_3^{II})_2^{II}$ is meant to formulate a compound in which the dyad R^{II} partially saturates $(R_2)^{VI}$, leaving it but four bonds out of six.

There are minerals scattered through the tables which defied all efforts of mine to bring them into the general fold of those possessing unity of formula, and these have been written simply empirically or with the *relative* number of atoms which their analysis showed, without any attempt to make a formula.

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PREFACE TO THE SECOND EDITION.

(1877.)

* * * * * * * * * * *

MINERALS without which the smallest collections would not be complete are printed without any mark. Those which, while common enough in collections of some size, might be absent from the very smallest, are furnished with a dagger (†). Minerals which are found only in the largest or finest collections are marked with a double dagger (‡).

* * * * * * * * * * *

It is with great satisfaction that I note in the lately-issued "Text-Book of Mineralogy by Mr. E. S. Dana, on the plan and with the co-operation of Professor James D. Dana" (New York, Wiley, 1877), that the principle which must govern the construction of mineral formulas,—*i.e.*, the unity of the mineral molecule,—and which I so strongly emphasized in the preface to the first edition, finds abundant recognition throughout. Not indeed everywhere, and not in the form of rational, but generally in that of empirical formulas: yet this latter form of stating the constituents of a mineral seems vastly preferable to that of separate compounds united by the sign plus (+). It cannot be doubted, either, that until we are more advanced in our knowledge of the conditions affecting the existence of the gaseous, the liquid, and more especially the solid molecule, the safest method of writing a mineral formula is the empirical. But who would shut his eyes to the lines of order which rational formulas point out, imperfect though they be?

* * * * * * * * * * *

A table of elements, with their atomic weights and valences, according to the most recent investigators, forms a new feature in this book. By its aid the percentage composition of any mineral in the tables may be calculated in the absence of handbooks containing the records of actual analyses.

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PREFACE TO THE THIRD EDITION.

(1891.)

THE first edition of this work was meant to be an English translation, with improvements earning for it the right to be considered a new edition, of the "Tabellen zur Bestimmung der Mineralien," by Professor Dr. Albin Weisbach; but before it was fairly commenced I saw that it would have to be modified in many particulars in order to meet the wants of American readers. The changes and additions were so numerous as to make virtually a new book, in which, however, the general plan sketched by Dr. Weisbach was followed. The Freiberg school in the hands of Werner and Breithaupt was essentially the physical school of mineralogy, great attention being paid to outward characteristics, and especially to crystal system and form. Its pre-eminence in these things was in no wise lost under Professor Dr. Weisbach; but the increase to our knowledge of minerals, both dependently and independently of chemical theory, has been so enormous; the points from which to view them, the methods applied to their determination, and the special workers have become so numerous, that Freiberg is no longer, as it was for many years, without a rival in the teaching of mineralogy. In crystallography her word is no longer final, while in the chemical philosophy and classification of minerals Freiberg has been fairly outstripped. Even at the time of the publication of the first edition of these tables no account was taken in Freiberg of the great progress in the science of chemistry, but the formulas of minerals were written in the style of the unfortunate reaction from the lucid views of Berzelius, with the symbol for the water molecule HO. This was why the present writer felt it important to calculate the chemical formulas of minerals in the first edition of this work according to the light of the "new"—really the old—chemical theory, and he believes that it was the first time that this had been done in this country.

It will appear, from the fragment of the preface to the first edition which is retained, that he did not presume that this effort would be successful in all cases; but, considering the fact that perhaps as much has been learned of minerals and of chemical theory relating to them since 1874 as had been acquired up to that date; and considering also the fact that in seeking for rational formulas out of a mass of analyses by different chemists, without the opportunity of practically testing his assumptions, he was groping in the dark, it is very gratifying to him to observe, that the most modern formulas by the masters of greatest authority agree in a large number of cases accurately with those presented in this book at that time. Still a greater number differ from his tentative formulas of 1874 only because of the additional and more accurate data concerning the respective minerals obtained since that date. He is also happy to note that the principle for which he then contended, of the unity of the mineral molecule, in opposition to the theory of Professor J. D. Dana, has been tacitly conceded by all modern writers, including Professor Dana himself.

In rewriting the tables from beginning to end at the present time it was clearly unnecessary to repeat the preliminary work in mineral formulas, which the writer had undertaken at a great disadvantage, because no authoritative references were to be had.

With a work at hand so universally accepted as that of Dr. P. Groth's "Tabellarische Uebersicht der Mineralien" the old formulas of the former edition of this work became superfluous, and were—it is true, somewhat regretfully—displaced to make room

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for their betters. Dr. Groth has been made the standard authority on crystal system and chemical formula throughout this work, though in the latter the order in which he has placed the elements in his formulas has been frequently changed to conform with the practice adopted in the earlier edition of placing the cations as much as possible first and the anions last.

On the other hand, Professor Weisbach's new edition of his tables (Leipzig, 1886), to which he has added a column for chemical formula, much needed in his earlier work, has been followed closely in descriptions of superficial appearance and in the valuable table of paragenesis.

The Freiberg school is still at the head of all others in the matter of systematic and exhaustive description of the appearance of the surface of minerals to the eye, of their fracture in small and large masses, and of their habit, structure, texture, and form as distinguished from their crystallization. In color, streak, hardness, tenacity, cleavage, and fracture, where the authorities differ, Professor Weisbach has been taken as the standard.

A new departure has been made in some of the terms used in describing a mineral, not without considerable reflection. The English vocabulary of mineralogy lacks many words of great utility in describing minerals. "Eingesprengt" has been rendered in other books "disseminated," or "diffused," but these words do not convey the picture to the mind of what is meant as well as "interspersed," which has been adopted in this work. "Muschlig," "schalig," and "schuppig" are rendered "conchoidal," "*shelly*," and "scaly" in the following pages. "Säulig" and "stänglig" are given as "columnar" and "stalky." The latter word is somewhat barbarous, but is believed to convey the idea as well as "stem-like," besides being shorter.

One who contends for elegant diction may be shocked to see Erythrite described as "warty," but the figure is graphic if homely. The greatest difficulty in choosing terms as equivalents was experienced when "broad stalky," "short stalky," "fine reniform," etc., were required. There was no help for it, however, short of periphrasis, which would have added to the size of the book without other advantage than euphony, and this, whether or not wisely, was thought an insufficient one.

The table of elements at the end of the book is that of Professor F. W. Clarke, chief chemist of the United States Geological Survey, calculated for the committee of revision and publication of the Pharmacopœia of the United States, adopted by that body, and recommended to American chemists universally in order that their results may be comparable. Professor Clarke is one of the highest American authorities on the subject of the atomic weights, and has in late years done much work in this direction. He has adopted oxygen as 16 for a base, and calculated the other atomic weights, both above it and below it, to correspond with this number. This has the advantage of giving a whole number to the element which enters more largely than any other into chemical calculations and reducing the error of those determinations where hydrogen must be multiplied as unity by large factors on the erroneous supposition that its relation to oxygen is as 1 : 16. It has the further merit that many of the atomic weights which, through scorn of Prout's supposed law, certain chemists have been writing with two decimals, come out so near whole numbers that they may be considered so. Professor Clarke's numbers, which are the result of diligent and intelligent labor, may be considered as a scientific plea in extenuation of Prout. But the main advantage of the adoption of this table is uniformity of language among chemists, an advantage of the metric system of weights and measures unhappily so long neglected. With a common table of constants the necessary corrections and emendations can be made simultaneously and without discordance, whereas with the present confusion of tables the real significance of an important correction of an atomic weight is often lost sight of. The writer's own experience in attempting to compile an accurate table of elements is a proof of this. Starting out with the table of Professor von Meyer, he wrote to some of the most eminent chemists here and abroad. The corrections to any given table were as numerous as the authorities he invoked. It was evident that numbers had been accepted without in all cases scrutinizing the data on which they were based, so that in any one table two or three discordant assumptions might be concealed.

The historical part of the tables is taken from a printed sheet prepared thirteen years ago by the writer for his chemical class in the Franklin Institute.

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Following the excellent plan of Weisbach's new table, notes as to the habit and structure of minerals have been added in the old column of "Crystal System," after the letters *H.* and *S.* respectively. The fracture has been appended to Cleavage, after the letters *Fr.* Under the column of "Remarks" are given the specific gravities ("G."), the chemical tests, etc., and the minerals associated with the species described ("*A.*").

I have omitted altogether the supplementary tables to assist in the determination of those minerals of non-metallic lustre and colorless streak which cannot be determined by the aid of simple instruments and a close observation of their physical characters, and placed the most important pyrognostic characteristics and physical and chemical tests of each mineral in the column of "Remarks." The reason for this change is that when a mineral fragment cannot be identified by such physical tests as are considered in this little book it is better to have recourse to a treatise on blowpipe or general qualitative analysis.

The distinctions which were made in the last edition between common, rare, and very rare minerals by printing the dagger or double dagger after the name of a species, have been in the main retained, but less attention to these marks has been given in the new species which have been added. In fact, nothing connected with minerals is so likely to change as their relative abundance. The discovery of a locality in which certain hitherto rare minerals are found in quantity will in a very short time flood the mineral market with them, so that it is hardly worth while to attempt a rating of their frequency of occurrence except in a periodical where constant revision is possible.

The synonyms of minerals have been more largely given than in the previous work, and in some cases, such as garnet, sub-varieties have been added after the synonyms without much notice of the distinction between the two. It is not thought, however, that this will cause any confusion, and the distinction is not always easy to make.

Abbreviations have been freely used, especially in the columns of "Crystal System" and in pyrognostic characters: as, hxhdl. for hexahedral, dodecl. (dodecahedral), r'dl. (rhombohedral), masv. (massive), retic. (reticulated), *ch* (on charcoal), etc. These abbreviations will be readily understood by all who have had preliminary instruction in mineralogy.

In conclusion, I wish to acknowledge my indebtedness for suggestions to Mr. C. Bement, Professor H. B. Cornwall, Professor Wolcott Gibbs, William Crookes, F.R.S., P.P.C.S., and very especially to Professor F. W. Clarke.

PHILADELPHIA, 1891.

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TABLE OF CONTENTS.

		PAGES
I	MINERALS OF METALLIC LUSTRE.	
	1. Red	2, 3
	2. Yellow	4 to 7
	3. White	6 to 13
	4. Gray	12 to 23
	5. Black	22 to 29
II	MINERALS OF SUB-METALLIC AND NON-METALLIC LUSTRE.	
	1. With Black Streak	30 to 33
	2. With Brown Streak	32 to 37
	3. With Red Streak	36 to 39
	4. With Yellow Streak	40 to 47
	5. With Green Streak	48 to 55
	6. With Blue Streak	54 to 57
III	MINERALS OF NON-METALLIC LUSTRE AND WHITE OR LIGHT GRAY STREAK.	
	1. Very Sectile	58 to 71
	2. Sectile	70 to 85
	3. Semi-Hard	84 to 91
	4. Hard	90 to 101
	5. Very Hard	100 to 107
	HISTORICAL TABLE OF ELEMENTS	108, 109
	SCALES OF HARDNESS AND FUSIBILITY	110
	INDEX	111 to 115

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TABLES

FOR THE

DETERMINATION OF MINERALS.

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I. MINERALS OF

1.

NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Copper	copper-red	copper-red	2.75	malleable
Bornite (Buntkupferkies, Erubescite)	between copper-red and bronze-yellow	black	3.50	sect. to brittle
Niccolite‡ (Nickelin, Arsennickel, Rothnickelkies)	light copper-red	brownish black	5.25	brittle
Breithauptite† (Antimonnickel)	copper-red violet hue	red-brown	5.5	brittle

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METALLIC LUSTRE.

Red.

CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Isom. *H.* octdl., hxdl., dodcl. *S.* masv., interspersed, coating, in sheets, lamellar, wiry.	*Fr.* hackly	Cu (oc. with Ag, As, Sb, Bi, etc.)	G. 8.9. BB *ch.* easily fusible, on cooling covered with black oxide. Sol. in nitr. ac., giving red fumes and penetrating odor; deep blue on addition of ammonia. *A.* In beds and veins usually near igneous rocks.
Isom. *H.* hxdl., dodcl. *S.* masv., interspersed.	.....	Cu_3FeS_3	G. ± 5.0. Copper-colored fresh fracture. BB fuses to brittle magnetic globule. Sol. in nitr. ac., with separation of sulphur. *A.* Chalcopyrite, Malachite, Chalcocite.
Hex. *H.* obtuse pyr. *S.* masv., interspersed.	.....	NiAs (oc. with Fe, Co, Sb, and S)	G. 7.5. Crystals rare. BB *ch.* arsenic fumes. Fuses to button. *A.* Chloanthite, Smaltite, Bismuth, Silver, Arsenic, Barite, Fluorite.
Hex. *H.* thin tab. *S.* intersp.	.....	NiSb (oc. with galena and tr. Fe)	G. 7.5. Weathers reddish blue. BB like Niccolite, but with reaction for Sb in place of As. *A.* Chloanthite, Galenite, Blende, Calcite.

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2.

NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Sternbergite‡ (Silberkies, in part)	pinchbeck-brown bronze-yellow	black	1.5	sectile
Gold	gold-yellow	gold-yellow	2.5	malleable
Electrum‡	yellowish white	yellowish white	2.5	malleable
Bornite† (Buntkupferkies, Erubescite)	reddish pinchbeck-brown	greenish black	3.5	brittle
Millerite† (Gelbnickelkies, Haarkies)	speiss to bronze-yellow	black to bright	4	brittle
Chalcopyrite (Kupferkies, Copper Pyrites)	brass-yellow	green black	4	sect. to brittle

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Yellow.

CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *H.* scaly. *S.* massive.	*Cl.* **0.** *Fr.* short fibrous.	$AgFe_2S_3$	G. 4.2. Generally brightly tarnished. BB fuses to magnetic button, on the surface of which separated metallic silver shows. Sol. in aqua regia, with separation of sulphur and AgCl. *A.* Pyrargyrite, Stephanite, Proustite, Arsenic, Barite.
Isom. *H.* octdl., hxhdl., dodecl. *S.* interspersed, masv., lamellar, coating.	.....	Au (usually with Ag)	G. 15.6–19.5. Crystals often deformed. BB fuses easily to gold-yellow button. Not sol. in any single acid. *A.* Pyrite, Galenite, Blende, Arsenopyrite, Antimonite, Quarts.
Isom. *H.* octdl., hxhdl. *S.* interspersed, masv., lamellar, coating.	.....	$xAu + yAg$	G. 12.5–15.5. BB, etc., see Gold and Silver. *A.* Pyrite.
Isom. *H.* hxhdl., dodecl. *S.* masv., interspersed.	*Cl.* **0**	Cu_2FeS_3	G. 5. Fresh surfaces after few hours tarnishing red, after longer time bluish red, reddish blue, and blue. (See I. 1.)
Hex. *H.* r'dl., capil., acic. *S.* masv., interspersed.	*Cl.* R perf. *Fr.* fibrous.	NiS (tr. Fe and Cu)	G. 5. Usually in capillary crystals or radiating tufts. BB in open tube SO_2. Fuses to a magnetic button. *A.* Chloanthite, Gersdorffite, Siderite, Barite, Fluorite.
Tetrag. *H.* pyr., sphenoidal. *S.* masv., interspersed, reniform.	*Cl.* **0** indistinct. 2–i oc. indistinct.	$(Cu_2)S_2(Fe_2)S_2$	G. 4.2. In matrass decrepitates and yields sulphur. In nitr. ac. green solution, with separation of sulphur. Solution becomes blue on addition of ammonia. *A.* Malachite, Bornite, Tetrahedrite, Galenite, Blende, Pyrite, etc.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Pyrrhotite (Magnetkies, Pyrrhotin)	bronze-yellow	black	4.5	brittle
Marcasite† (Speerkies, Kammkies)	white speiss-yellow	black	6	brittle
Pyrite (Mundic Schwefelkies, Eisenkies, Iron Pyrites)	pale brass-yellow	black	6.5	brittle

3.

Mercury†	tin-white	.....	liquid	.....
Sylvanite	tin-white	.....	.....	.....
Bismuth†	silver-white with reddish hue	gray	2.25	sect. to brittle
Tellurium†	tin-white	gray	2.5	brittle to sect.

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Hex. *H.* tab. *S.* masv., interspersed.	*Cl.* **0** perf. I less so.	$Fe_{11}S_{12}$	G. 4.5. In great part magnetic, frequently containing Ni. Crystals rare. BB fuses to black magnetic mass. O.F. red. *A.* Pyrite, Chalcopyrite, Galenite, etc., etc.
O'rhm. *H.* tab., colmn., pyrdl. *S.* reniform, massive.	*Cl.* I rather perfect. *Fr.* fibrous, fine-gr., compact.	FeS_2	G. 4.7. BB, etc., like Pyrite. *A.* Pyrite, Blende, Galenite, Arsenopyrite.
Isom. *H.* hxhdl., dodecl., octdl. *S.* reniform, lumpy, masv., interspersed.	*Cl.* **0** more or less distinct. *Fr.* fine-gr., compact, fibr.	FeS_2	G. 5. In closed tube, subl. of sulphur and magnetic residue. *A.* Galenite, Blende, Arsenopyrite, Magnetite, Specularite, Siderite, etc.

White.

Isom. (in artificial crystals)	.....	Hg (often with a little Ag)	G. 13.5. BB volatile and condensing in drops.
.....	.....	.....	.....
Hex. *H.* r'dl. *S.* interspersed, massive.	*Cl.* **0** perf. 2,–2 less so.	Bi	G. 9.7. Often brightly tarnished. Crystals very rare. Melts in candle flame. BB fuses, volatilizes. Crystallizes on cooling. *A.* Smaltite, Chloanthite, Barite, Cassiterite, Wolframite, Molybdenite.
Hex. *H.* r'dl., short acic. *S.* masv., interspersed.	*Cl.* I perf. *Fr.* fine-grained.	Te	G. 6.2. Melts in candle flame. BB fuses, volatilizes, gives green tinge to flame, and white coat. *A.* Gold, Sylvanite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Hessite‡ (Tellursilber, Tellursilberglanz)	lead-gray to steel-gray	gray	2.5	malleable
Silver	silver-white	silver-white	3	malleable
Amalgam† (Arquerite, Kongsbergite)	silver-white	gray	3	brittle
Antimony†	tin-white	gray	3	sect. to brittle
Altaite‡ (Tellurblei)	tin-white to yellow-white	gray	3.25	sectile
Domeykite‡ (Arsenkupfer)	tin-white			

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Isom. *S.* massive.	*Cl.* indistinct. *Fr.* fine-grained.	Ag_2Te	G. 8.5. (Var. Petzite, iron-black,—brittle. G=9,—contains Gold.) Melts in candle flame. Tarnishes black. BB R.F. fuses and, cooling, shows white, dendritic silver. *A.* Native Gold.
Isom. *H.* hxhdl., octdl. *S.* masv., interspersed, hackly, capil., lamel., coating, retic.	.....	Ag	G. 10.5. Often tarnished yellow, brown, or black. Crystals often deformed. BB fuses easily to white button. O.F. faint red coating of oxide. Crystallizes on cooling. Sol. in HNO_3, precip. by HCl. *A.* Argentite, Pyrargyrite, Proustite, Barite, Quartz.
Isom. *H.* dodecl. *S.* masv., interspersed, coat'g.	.....	(Ag,Hg)	G. 10.5–14. BB mercury volatile, silver left. (See preceding.) *A.* Cinnabar.
Hex. *H.* r'dl. *S.* interspersed, massive.	*Cl.* 0 perf. R and — ½ R distinct. *Fr.* granular.	Sb	G. 6.6. Crystals very rare and small. Melts in candle flame. BB fuses, giving white coat. When heat ceases the button continues to glow, giving white fumes and crusting over with oxide. The white coat colors the R.F. bluish green. Crystallizes from fusion. *A.* Antimonite, Kermesite, Smaltite.
Isom. *H.* hxdl. *S.* massive.	*Cl.* hxdl., distinct	PbTe	G. 8.1. Lustre very brilliant. BB entirely volatile. Fuses to button, coloring flame bluish, and giving coal lustrous metallic coating. *A.* Hessite.
(?) *S.* masv., interspersed.	*Fr.* uneven	Cu_3As	G. 7.5. BB arsenic fumes and malleable button of copper. Sol. in HNO_3 but not in HCl. Algodonite (Cu_6As) and Whitneyite (Cu_9As) are allied species.
O'rhm. *H.* colmn., tab., obtuse pyr. *S.* masv., interspersed.	*Cl.* 0 distinct. *Fr.* gran., uneven.	Ag_2Sb (?)	G. 9.5. Often tarnishes dark gray. Melts in candle flame. BB fuses to button, coating coal with white antim. ox. and leaving pure silver. *A.* Galenite, Arsenic, Pyrargyrite, Silver, Smaltite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Löllingite (Arsenikalkies, Pharmakopyrite)	tin-white	grayish black	5	brittle
Smaltite (Chloantite, Weissnickelkies)	tin-white	gray	5	brittle
Gersdorffite† (Graunickelkies, Arsennickelkies)	tin-white to blue-gray	lead-gray to tin-white	5	brittle
Linnæite† (Kobaltkies)	red silver-white	grayish black	5.25	brittle
Cobaltite (Kobaltglanz, Kobaltin)	red silver-white	grayish black	5.5	brittle
Arsenopyrite (Mispickel, Arsenkies)	tin-white	grayish black	5.5	brittle
Ullmannite‡ (Antimonnickelkies)	tin-white	black	5.5	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *H.* acic. *S.* masv., interspersed.	*Fr.* compact, fine gran., stalky, fibrous.	$FeAs_2$	G. 6.8. Crystals rare. Closed tube, subl. of As. BB odor of As and magnet. button. *A.* Galenite, Blende, Pyrite, Magnetite, Cassiterite, Siderite.
Isom. *H.* hxdl. *S.* masv., interspersed, reticulated.	*Fr.* compact, short fibrous, fine gran.	$(Co,Fe,Ni,)As_2$	G. 6.8. Often with apple-green coating. In closed tube As. BB arsenical odor, and fuses to button containing Fe,Co,Ni. *A.* Niccolite, Bismuth, Proustite, Barite, Fluorite, Siderite.
Isom. *H.* octdl. *S.* massive.	*Cl.* cub. (rather perf.)	$Ni_{(Fe)}AsS$	G. 6. In closed tube decrep. and deposits sulphide of arsenic. Decomp. by HNO_3, with formation of green sol. and separation of S and As_2O_3. *A.* Niccolite, Siderite.
Isom. *H.* octdl.	.....	$(Ni,Co,Fe,)_3S_4$	G. ± 4.9. BB As and S odor. Fuses to magnetic button. Sol. in HNO_3 with separation of S. *A.* Chalcopyrite, Tetrahedrite, Siderite.
Isom. *H.* hxdl., octdl., dodecl. *S.* masv., interspersed.	*Cl.* cub. (perf.) *Fr.* gran.	$(Co,Fe)AsS$	G. 6. BB gives off S and As and fuses to magnet. button. Sol. in warm HNO_3, separating arsenic oxide and sulphur. *A.* Chalcopyrite, Pyrrhotite (Magnetopyrite), Molybdenite, Amphibole, Pyroxene.
O'rhm. *H.* colmn., acic., tab., pyr. *S.* masv., interspersed.	*Cl.* I (seldom). *Fr.* fine gran., thin stalky.	$FeAsS$ or $Fe(AsS)_2$	G. 6. Crystals deficient in facets. Often tarnished gray or bright. BB As odor. Gives magnetic button. Decomp. by HNO_3, separating arsenic acid and S. *A.* Blende, Galenite, Chalcopyrite, Pyrite, Magnesite, Cassiterite.
Isom.	*Cl.* cub. (perf.)	$NiSbS$	G. 6.3. Closed tube, faint white subl. Open tube, sulph. and antimon. fumes, the latter condensing on the sides, and not vol. BB fuses to button, boils and gives antimon. vapors which coat coal. Decomp. by HNO_3, forming green sol., with separation of sulphur and antimon. ox. *A.* Galenite, Chalcopyrite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Skutterudite‡ (Tesseralkies)	tin-white	grayish black	5.75	brittle
Iridosmine‡ (Sisserskite) (Newjanskite)	tin-white	grayish black	7	brittle

4.

Molybdenite (Molybdänglanz)	reddish lead-gray	bluish gray, lustrous	1.5	sectile to malleable
Nagyagite‡ (Blättertellurerz)	black lead-gray to iron-black	grayish black	1.5	sectile to malleable
Sylvanite† (Schrifterz)	light steel-gray	gray	2	sectile
Pyrolusite (Weichmanganerz)	dark steel-gray to light iron-black	black	2	sect. to brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Isom. *H.* octdl. *S.* massive.	*Cl.* cub. (distinct)	$CoAs_3$	G. 6.7. In matrass subl. of met. arsenic. Open tube white fumes of arsen. acid. BB As odor. Fuses to button. *A.* Cobaltite and ores of Co, Ni, Cu, Ag.
Hex. *H.* r'dl, scaly.	*Cl.* 0	$xIr + yOs$ (with Rd, Pt, Cu, Fe, Ru)	G. 19.3–21.12. BB infusible. At high temp. Sisserskite gives off Osmium, but suffers no other change. Newjanskite gives no Osmium odor till fused with nitre. *A.* Gold and Platinum.

Gray.

Hex. *H.* fine tab., scaly. *S.* interspersed, massive.	*Cl.* basal (perfect.) *Fr.* thin shelly	MoS_2	G. ± 4.6. Gray streak on paper and unglazed porcelain. Greenish streak on glazed porcelain. Unctuous to touch; cut by the nail. Laminæ flexible but not elastic. BB yellowish green flame. In O.F. odor of SO_2 and coats coal with MoO_3. Yellow hot; white, cool, and red near substance. With intermittent flame azure blue. Decomp. by nitr. ac. with residue of MoO_3. *A.* Wolframite, Arsenopyrite, Cassiterite, Magnetite, Blende, Pyrite.
O'rhm. *H.* fine tab., scaly. *S.* interspersed.	*Cl.* basal (perfect)	$Au_2Pb_{14}Sb_3(S,Te)_{24}$	G. 6.9. BB two coats, most distant white and volatile, that nearest substance yellow. *A.* Blende, Tetrahedrite, Rhodocrosite, Sylvanite.
Mcl. *H.* short acic., scaly. *S.* interspersed.	*Cl.* i–ì (distinct)	$(Ag,Au)Te_2$	G. ± 8.15. In open tube white subl., gray near substance, fusing BB to clear, transparent drops. *Ch.* fuses and gives white coat, which in R.F. disappears, giving bluish-green color to flame. *A.* Tetrahedrite, Blende.
O'rhm. (pseud.) *H.* colmn., acic., capil. *S.* massive.	*Fr.* stalky, fibr., gran.	MnO_2 with 2 p. c. H_2O	G. 4.8. Blackens objects touched. BB infusible. Loses oxygen. Gives Cl with HCl. *A.* Psilomelane, Barite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Tetradymite† (Tellurwismuth)	pale steel-gray to silver-white	dark gray	2	sectile to malleable
Jamesonite† (Federerz)	black lead-gray to steel-gray	gray-black	2.5	sect. to brittle
Emplectite† (Kupferwismuthglanz)	tin-white to light steel gray	gray-black	2.5	sect. to brittle
Stibnite (Antimonite) (Grauspiessglaserz) (Antimonglanz)	lead-gray	grayish black	2.5	sectile
Freieslebenite‡ (Schilfglaserz) (Diaphorite with same formula crystallizes O'rhmb.)	steel-gray to black lead-gray	gray-black	2.5	sect. to brittle
Argentite	black lead-gray	gray-black lustrous	2.5	malleable

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS, Sp. Gr., Reactions. *A* = Associated Minerals.
Hex. *H.* acute r'dl., scaly, tab. *S.* massive.	*Cl.* basal (perfect)	$Bi_2(Te,S)_3$	G. 7.2–7.9. Crystals small. Melts in candle flame. Laminæ flexible. Marks paper. Open tube white subl. of tellur. oxide, which BB fuses to colorless drops. *Ch.* fuses, white fumes, and entirely vol. Tinges R.F. bluish green. Coats first white and then orange-yellow. *A.* Gold.
O'rhm. *H.* acic., capil. *S.* massive.	*Cl.* basal (distinct). *Fr.* stalky, fibr., compact.	$Pb_2Sb_2S_5$	G. 5.7. Melts in candle flame. Decrepitates, subl. of Sb_2S_3. BB almost entirely vol., giving coat white near outer edge, yellow near assay. *A.* Galenite, Bournonite.
O'rhm. *H.* acic. *S.* massive.	*Cl.* i–ī (perfect). **0** distinct. *Fr.* thin, stalky.	$Cu_2(Bi,S_2)_2$	G. 5.15. Melts in candle flame. Often tarnishes yellow. BB *ch.* fuses easily with frothing and spirting. With soda coats dark yellow from Bi_2O_3 and gives button of Cu. *A.* Chalcopyrite.
O'rhm. *H.* acic., tab., columnar. *S.* stalky, fibr., gran., compact.	*Cl.* i–ī (highly perfect). Cl. planes often striated.	Sb_2S_3	G. 4.5. Often tarnished in bright colors. Melts in candle flame. Open tube S and Sb fumes, the latter not vol. BB *ch.* white coat, coloring greenish blue in R.F. Sol. in HCl. *A.* Siderite, Blende, Barite, Quartz, Pyrite, Gold.
Mcl. *H.* short acic. *S.* masv., interspersed.	*Fr.* compact, fine grained	$(Pb,Ag_2)_5Sb_4S_{11}$	G. ± 6.2. Melts in candle flame. BB *ch.* coats white on outer edge, yellow near substance. R.F. silver button. *A.* Pyrargyrite, Barite, Siderite.
Isom. *H.* hxhdl., octdl., dodecl. *S.* masv., interspersed, coating, lamellar, reticulated.	.....	Ag_2S	G. 7.2. BB *ch.* fuses with intumescence, emitting S fumes, and yielding Ag button. *A.* Pyrargyrite, Proustite, Silver, Galenite, Blende, Niccolite, Barite, Fluorite, Siderite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Bismuthinite† (Wismuthglanz)	light steel-gray	black	2.5	sect. to brittle
Clausthalite‡ (Selenblei)	lead-gray	grayish black	2.5	sectile
Zinckenite‡ (Bleiantimon-glanz)	lead-gray	grayish black	2.5	sect. to brittle
Galenite (Bleiglanz)	reddish lead-gray	dark gray	2.75	sectile
Chalcocite (Kupferglanz)	black lead-gray	dark gray	2.75	sect. to brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *H.* capil., acic. *S.* massive.	*Cl.* i–I (perf.)	Bi_2S_3	G. 6.4. Melts in candle flame. In open tube S fumes and white subl., which BB fuses into drops. Brown when hot and opaque yellow cold. *Ch.* fuses, with spirting, and coats yellow. Dissolves in nitr. ac., and white precip. falls on diluting with water. *A.* Bismuth, Chalcopyrite, Gersdorffite, Siderite, Cassiterite, Wolframite, Molybdenite.
Isom. *S.* interspersed, massive.	*Cl.* cubic (perfect). *Fr.* fine-gr.	PbSe	G. 7.6 to 8.8. BB decrepitates in closed tube. Open tube, selenous fumes and red subl. *Ch.* gray near substance, with red border. Later, yellow. Partially fusible. Entirely vol. Resembles Galenite, but BB distinguish it. *A.* Gold.
O'rhm. *H.* acic., colmn. *S.* massive.	*Fr.* stalky	$PbSb_2S_4$	G. 5.3. Crystals seem hex. Melts in candle flame. Decrep. and fuses easily. BB almost entirely vol. Coat yellow near substance, white further off. Sol. in hot HCl, evolving H_2S and precip. $PbCl_2$ on cooling. Resembles Stibnite and Bournonite, but is harder and heavier. *A.* Galenite, Antimonite.
Isom. *H.* hxhdl., octdl. *S.* masv., interspersed, coating, tab.	*Cl.* cubic (perfect). *Fr.* gran., compact, thin scaly, broad stalky.	PbS	G. 7.5. BB *ch.* coats coal yellow and gives button of lead. Sol. in nitr. ac. *A.* Blende, Chalcopyrite, Pyrite, Barite, etc. In veins and beds.
O'rhm. *H.* tab., short acic., obtuse pyr. *S.* masv., interspersed, tab.	*Cl.* **0** distinct	Cu_2S	G. 5.7. BB yields nothing vol. in closed tube. SO_2 in open tube. R.F. with soda metallic Cu. *A.* Chalcopyrite, Bornite, Tetrahedrite, Malachite, Pyrite, Barite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Bournonite† (Rädelerz)	steel-gray to iron-black	grayish black	2.75	brittle to sect.
Boulangerite†	lead-gray	grayish black	2.75	sect. to brittle
Wittichenite‡	lead-gray to iron-black	grayish black	2.75	sectile
Tiemannite‡ (Selenqueck-silber)	lead-gray	grayish black	2.75	sect. to brittle
Stephanite† (Brittle silver ore, Melanglanz)	black lead-gray to iron-black	grayish black	2.75	sect. to brittle
Berthierite†	lead-gray to dark steel-gray	grayish black	3	brittle
Dufrenoysite‡	blackish lead-gray	reddish brown	3	very brittle

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O'rhm. *H.* tab., cuboid, obt. pyr. *S.* masv., intsp.	.....	$Pb_2Cu_2Sb_2S_6$	G. 5.8. Crystals seem tetragonal. Multiple twin structure. Often cruciform. In closed tube, decrep. and gives dark-red subl. BB *ch.* fuses easily and coats white outside and yellow near substance. R.F. with soda, button of Cu. Decomp. by nitr. ac., leaving residue of S, and white powder containing Sb, and Pb in blue solution. *A.* Tetrahedrite, Galenite, Chalcopyrite, Arsenopyrite, Siderite, Barite.
O'rhm. *S.* massive.	*Fr.* thin stalky, fibr., compact	$Pb_3Sb_2S_6$	G. 5.8. Melts in candle flame. BB, see ZINCKENITE. *A.* Galenite, Antimonite.
O'rhm.	.....	$(Cu_2)_3Bi_2S_6$	G. 5. BB fuses easily, emits sparks. Coats coal with bismuth oxide. Sol. in HCl, ac. with evolution of H_2S. Decomp. by nitr. ac. with separation of S. *A.* Barite.
Isom. *H.* tetrdl.	.....	Hg Se	G. 7.2. Decrepitates and sublimes in closed tube, giving black subl., upper edge reddish brown. Open tube, odor of Se. Forms dark reddish brown subl., with border of white selenate of Hg. BB *ch.* volatile, coloring outer flame azure and leaving metallic coating. *A.* Chalcopyrite.
O'rhm. *H.* tetrdl., thick tab., short and long colmn. *S.* masv., interspersed.	.....	$Ag_{10}Sb_2S_8$	G. 6.2. Crystals seem hxgnl. Melts in candle flame. BB *ch.* fuses with spirting. Coats coal with antimony oxide, and gives button of silver. Soluble in dilute hot nitr. ac., precipitating S and antimony oxide. *A.* Argentite, Silver, Pyrargyrite, Barite.
(?) *H.* capillary. *S.* massive.	*Cl.* in one direction. *Fr.* thin stalky, fibr.	$FeSb_2S_4$	G. 4.1. Melts in candle flame. Often brightly tarnished. BB *ch.* gives off S and Sb fumes. Coats coal white and leaves black magnetic slag. Dissolves in HCl, giving off H_2S. *A.* Antimonite, Blende.
O'rhm. *H* thick tab.	*Cl.* 0 (perf.)	$Pb_2As_2S_5$	G. 5.5. BB *ch.* decrepitates, melts, yields fumes of As and button of argentif. lead. *A.* Sartorite, Jordanite, Binnite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Sartorite‡ (Scleroclase, Bleiarsenglanz)	light lead-gray	reddish brown	3	very brittle
Miargyrite† (Silberantimonglanz)	steel-gray to iron-black	dark cherry-red	3	sect. to brittle.
Arsenic†	lead-gray to tin-white	grayish black	3.5	brittle to sect.
Tetrahedrite (Antimonfahlerz. Common variety)	dark steel-gray lead-gray iron-black	black in part, inclining to cherry-red	3.5	brittle
Tetrahedrite (Tennantite, Arsenfahlerz)	dark steel-gray	dark red-gray to dark cherry-red	3.5	brittle
Tetrahedrite† (Hermesite, Quecksilberfahlerz)	steel-gray	black	3.5	brittle to sect.
Stannite† (Stannin, Zinnkies)	steel-gray to gray	black	3.5	brittle
Manganite (See I. 5)	dark steel-gray	reddish brown	4.25	sect. to brittle
Gersdorffite† (Graunickelkies, Arsennickelkies)	lead-gray to tin-white	grayish black	5	brittle

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O'rhm.	*Cl.* **0** distinct	$PbAs_2S_4$	G. 5.4. BB nearly the same as Dufrenoysite, but differing in strong decrepitation. *A.* Dufrenoysite, Binnite.
Mcl. *H.* thick tab., short colmn. *S.* massive.	.....	$AgSbS_2$	G. 5.3. Melts in candle flame. BB *ch.* fuses to gray bead, emitting S and Sb fumes. In O.F. leaves button of Ag. *A.* Pyrargyrite.
Hex. *H.* rhdrl.	*Cl.* **0** perfect. R and $-\frac{1}{2}$ R distinct.	As	G. 5.9. Fresh surfaces of fracture tarnish in short time to grayish black. Vol. without melting. Crystals very rare and small. Ignites in candle flame. BB *ch.* odor of garlic. Coats with As oxide. Coating vol. in R.F., tingeing flame blue. *A.* Proustite, Galenite, Chloanthite, Barite, Calcite.
Isom. *H.* tetrdl., dodecl., $\frac{m.m}{2}$. *S.* masv., intsp.	.....	$(Cu_2Ag_2,Fe,Zn)_4Sb_2S_7$	G. 4.5–5.1. BB *ch.* fuses, giving coating of antimony oxide. Decomp. by nitr. ac., with separation of S and antimon. ox. *A.* Chalcopyrite, Galenite, Bournonite, Blende, Siderite, Rhodocrosite, Barite.
Isom. *H.* tetrdl., dodecl. *S.* masv., intsp.	.....	$(Cu_2,Fe,Zn)_4As_2S_7$	G. ± 4.7. BB, etc., as in preceding, with As ox. for Sb ox. *A.* Chalcopyrite, Galenite, Blende.
Isom. *H.* tetrdl.	.....	$(Cu_2,Hg_2,Fe,Zn)_4(Sb,As)_2$	G. ± 4.7. Melts in candle flame. BB faint dark gray subl. at low red heat. Fused with soda in matrass drops of Hg condense on sides. *A.* Cinnabarite, Chalcopyrite, Siderite, Barite.
Isom. *H.* hemihdrl. *S.* massive.	*Fr.* compact, fine-grained	Cu_2FeSnS_4	G. 4.4. Tarnishes bronze-yellow. Gives no malleable button. Sol. in nitr. ac., with separation of S and SnO_2. *A.* Chalcopyrite, Cassiterite, Arsenopyrite, Galenite, Blende.
O'rhm.	i–ĭ, I	MnO,OH	G. 4.3. (See I. 5.)
Isom. *H.* octdl. *S.* massive.	*Cl.* cubic rather perfect. *Fr.* granular.	(Ni,Fe)AsS	G. 6. Often tarnishes dark gray. Decrepitates and gives subl. of As sulphide. BB sulph. and garlic odor. Decomp. by nitr. ac., forming green solution, separating S and As ox. *A.* Niccolite, Siderite.

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Smaltite (Smaltin, Speiskobalt)	steel gray to blue-gray	grayish black	5	brittle
Platinum†	light steel-gray	gray	5.75	malleable
Iron (Meteoric)	light steel-gray	gray	6	malleable
Polianite† (Var. Pyrolusite)	light steel-gray	grayish black	6	brittle
Rutile (See II. 2)	brownish gray	yellowish red	6.5	brittle
Hematite (Specularit, Eisenglanz, Rotheisenerz)	steel-gray to iron-black	cherry-red brown-red reddish brown	6.5	brittle

5.

Graphite	iron-black	black	1	sectile to malleable
Nagyagite (Blättertellurerz) (See I. 4)	iron-black	grayish black	1.5	sectile to malleable

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Isom. *H.* hemihdrl. *S.* masv., interspersed, reniform, retic.	*Fr.* compact, short fibr., fine-grained	$(Co,Fe,Ni)As_2$	G. 6.7. Often with peach-blossom tarnish or dark gray. BB *ch.* garlic odor and fuses to a button. *A.* Niccolite, Bismuth, Barite, Fluorite.
Isom. *H.* hxhdl. *S.* free grains, and intersp. in lumps.	*Fr.* angular, granular	Pt (containing Fe, Ir, Os, etc.)	G. 16–19. Tarnishing grayish black. Infusible. Insoluble in single acids. Soluble in aq. reg. *A.* Chromite, Gold, Iridosmine.
Isom. *S.* masv., interspersed.	*Cl.* cubic partly distinct	Fe (containing Ni, Co, Si, Mg, etc.)	G. 7.5. Magnetic. BB infusible. Sol. in HCl. Generally meteoric.
Tetrag. *H.* short colmn, short acic. *S.* masv., reniform.	*Cl.* I distinct ii less so	$Mn\,Mn\,O_4$	G. 4.8. BB *ch.* infusible. Loses oxygen. Mn reaction with borax. Gives Cl with HCl. *A.* Pyrolusite, Barite.
Tetrag.	*Cl.* ii	$Ti\,Ti\,O_4$	G. 4.
Hex. *H.* r'drl., lentic., pyr., scaly, tab. *S.* masv., intsp.	*Cl.* R seldom distinct. *Fr.* gran., stalky, scaly, slaty, compact.	Fe_2O_3	G. 4.8. BB infusible. Sometimes magnetic and magneto-polar. Often tarnished in bright colors. Reactions for iron. *A.* Limonite, Göthite, Pyrolusite, Psilomelane.

Black.

Hex. *H.* r'drl., thin tab., scaly. *S.* masv., intsp.	*Cl.* **0** perfect. *Fr.* scaly, compact.	C (with impurities, chiefly Fe_2O_3)	G. 2.15. Greasy feel. BB burns without melting. Soils white paper. Unaltered by acids. *A.* Gneiss, Mica-slate, Limestone.
Tetrag.	*Cl.* **0** perfect	.....	G. 6.9

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Pyrolusite (Weichmanganerz)	light iron-black to dark steel-gray	black	2	sect. to brittle
Acanthite†	iron-black	gray-black	2.5	malleable
Polybasite† (Eugenglanz, Sprödglaserz, in part)	iron-black	black	2.5	sect. to brittle
Stromeyerite‡ (Silberkupferglanz)	iron-black	black, lustrous	2.75	sect. to malle.
Wittichenite‡ (See I. 4)	iron-black to lead-gray	gray-black	5.75	sectile
Stephanite† (Melanglanz, Sprödglaserz. in part)	iron-black to black lead-gray	gray-black	2.75	mild
Chalcocite (Kupferglanz) (See I. 4)	black lead-gray to iron-black	black	2.75	sect. to malle.
Bournonite† (See I. 4)	iron-black to steel-gray	gray-black	2.75	brittle to mild
Enargite‡	iron-black	black	3	brittle
Miargyrite† (See I. 4)	iron-black to steel-gray	dark cherry-red	3	sectile

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *H.* colmn., acic., capil. *S.* massive.	*Fr.* stalky, fibr., gran.	MnO_2 (with 1 or 2 p. c. H_2O)	G. 4.8. Infusible. Soils white paper. BB *ch.* loses oxygen. Gives Cl with HCl. *A.* Psilomelane, Barite.
O'rhm. *H.* dart-like, in blades.	.....	Ag_2S	G. 7.2. BB yields SO_2, and gives silver button with soda. *A.* Argentite.
O'rhm. *H.* scaly, tab. *S.* interspersed.	*Cl.* **0** (dist.)	$(Ag,Cu)_{16}(Sb,As)_2S_{12}$	G. 6.2. Translucent in thin slabs. Melts in candle flame. BB *ch.* fuses, with spirting, to button, giving S and Sb fumes. *A.* Stephanite, Argentite, Siderite, Fluorite, Barite.
O'rhm.	*Fr.* sub-conchoidal	$(Cu,Ag)_2S$	G. 6.2. Closed tube, fuses; gives no subl. Open tube, S fumes. BB *ch.* O.F. fuses to semi-malleable button. Sol. in nitr. ac.
O'rhm.	.....	$(Cu_2)_3Bi_2S_6$	G. 5.
O'rhm. *H.* thick tab., short and long columnar. *S.* masv., interspersed.	.....	$Ag_{10}Sb_2S_8$	G. 6.2. Crystals seem hex. Melts in candle flame. BB *ch.* fuses, throwing off small particles. Coats coal with Sb ox. After time red, from oxidized silver. Sol. in hot nitr. ac., depositing S and Sb. *A.* Argentite, Pyrargyrite, Silver, Barite.
O'rhm.	*Cl.* **0**	Cu_2S	G. $\pm$ 5.6.
O'rhm. *H.* short colmn, tab., cuboid, obtuse pyr.	.....	$Pb_2Cu_2(SbS_3)_2$	G. 5.8.
O'rhm. *H.* short colmn, short acic. *S.* massive.	*Cl.* I perfect ii } dist. ii }	Cu_3AsS_4	G. 4.4. BB in closed tube decrep. and gives subl. of S; at higher temp., subl. of arsenous sulphides. Fuses on *ch.* and gives button of copper. *A.* Tennantite, Chalcopyrite.
Mcl.	.....	$Ag(SbS_2)$	G. 5.3. (See I. 4.)

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Tetrahedrite‡ (Antimonfahlerz) (See I. 4)	iron-black	brown black	3.5	brittle
Alabandite‡ (Manganblende)	iron-black	dark green	3.75	brittle to sect.
Manganite†	iron-black	reddish brown	4.25	sect. to brittle
Melaconite† (Tenorite)	iron-black	black	5	brittle to sect.
Hausmannite†	iron-black	brown sometimes reddish brown	5.5	brittle
Magnetite (Magneteisenerz)	iron-black	blackish gray	5.5	brittle
Menaccanite† (Ilmenite, Titaneisenerz)	iron-black	black reddish brown	6	brittle
Chromite† (Chromeisenerz)	iron-black	dark brown to light brown	6	brittle
Braunite (Marcellin) (See II. 1)	iron-black	brownish black	6.25	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Isom.	.....	.....	G. 4.5 to 5.1. (See I. 4.)
Isom. *H.* octdl.	*Cl.* cubic (distinct)	MnS	G. 4. Often tarnishes dark brown. BB infusible. *A.* Blende, Rhodocrosite.
O'rhm. *H.* acic., colmn. *S.* massive.	*Cl.* ii very perf. I perfect. *Fr.* thin stalky, fibr.	MnO.OH	G. 4.3. BB infusible. Yields water. Borax and mrcrsm. salt, amethystine bead; colorless in R.F. Gives Cl with HCl. *A.* Barite, Calcite.
Mcl. (?)	.....	CuO	G. 6. Usually in scales. Soils fingers. BB O.F. infus. Colors flame green. Moistened with HCl, azure blue. Sol. in concentrated HCl. *A.* Found in lava on Vesuvius and in some copper mines.
Tetrag. *H.* acute pyr. *S.* massive.	*Cl.* 0 distinct. *Fr.* granular.	Mn_2MnO_4	G. 4.7. BB infusible. (See MANGANITE, above.) *A.* Pyrolusite, Psilomelane, Braunite, Barite.
Isom. *H.* octdl., dodecl. *S.* masv., intsp.	*Fr.* compact, granular	$Fe(FeO_2)_2$	G. ± 5. Strongly magnetic. BB fusible with great difficulty. In oxidizing flame loses magnetism. Sol. in HCl. *A.* In eruptive and metamorphic rocks.
Hex. *H.* r'drl., tab. *S.* masv., interspersed.	*Cl.* R rarely. *Fr.* granular.	$(Fe,Ti)_2O_3$	G. 4.7. BB infusible. Partly magnetic. O.F. slightly rounded on edges. With mrcrsm. salt reaction for iron. In R.F., treated with tin, violet color. Powdered and heated with HCl, slowly dissolved to yellow sol. *A.* Rutile, Titanite, Apatite, Feldspar.
Isom. *H.* octdl. *S.* masv., interspersed.	*Fr.* granular, compact	$(Fe,Cr)[(Cr,Fe)O_2]_2$	G. 4.3. Crystals small and rare. Usually slightly magnetic. BB infusible. With borax and mrcrsm. salt, iron reaction hot and chrome-green cold. *A.* In Serpentine.
Tetrag.	*Cl.* I	$MnMnO_3$	.....

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NAME.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Franklinite†	iron-black	reddish brown	6.25	brittle
Rutile (See II. 2)	iron-black	yellowish brown	6.5	brittle
Hematite (Specularite)	iron-black to steel-gray	cherry-red brown-red black-red	6.5	brittle
Columbite (Niobite)	iron-black	brownish black	6	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions, *A* = Associated Minerals.
Isom. *H.* octdl. *S.* massive.	*Fr.* compact	$(Fe,Mn,Zn)(FeO_2)_2$	G. 5. BB infusible. Slightly magnetic. With borax in O.F. reddish amethyst bead (Mn), and in R.F. bottle-green (Fe). *A.* Zincite, Willemite.
Tetrag.	*Cl.* ii, I	$Ti\,Ti\,O_4$	G. 4.
Hex. *H.* r'drl., tab., pyr.	*Cl.* R (seldom distinct)	Fe_2O_3	G. 4.8. BB infusible. Sometimes magnetic and magneto-polar.
O'rhm.	*Cl.* ii distinct	$[(Nb,Ta)O_3]_2Fe$	G. 6. BB infusible. Like Tantalite. Decomp. by fusion with potash, and treated with HCl and H_2SO_4 gives on addition of Zn a blue color. *A.* Beryl in Granite.

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II. MINERALS OF SUB-METALLIC

OF BLACK, BROWN, RED,

1. Of Black Streak

NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Asbolite† (Erdkobalt)	slightly resinous	bluish black	bluish black	1.25	sectile to malleable
Asphaltum† (Erdpech)	resinous	pitch-black	black to brown	1.25	sectile
Covellite† (Kupferindig)	sub-metal. to adamantine	dark blue indigo-blue steel-blue	blue-black	1.5–2	sectile to brittle
Bituminous Coal (A rock)	resinous to vitreous or silky	black partly brown	black	2.5	sectile to brittle
Anthracite (A rock)	sub-metallic vitreous	black	black	2.75	very brittle
Enargite (See I. 5)	sub-metallic	iron-black	black	3	brittle
Sphalerite† (Blende, Zinkblende)	vitreous	black	brownish black	4	brittle

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AND NON-METALLIC LUSTRE

YELLOW, GREEN, OR BLUE STREAK.

(all Opaque).

CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Amorphous. *S.* botryoidal, massive, powdery, coating.	.....	$Co(Fe,Cu)O + xH_2O$	G. ± 3.5. Unctuous. Variety of Wad. BB infusible. Blue bead with mcrcsm. salt. *A.* Malachite, Barite, Tetrahedrite.
Amorphous. *S.* massive, incrustations.	*Fr.* conchoidal	$C_{14}H_{18}O$	G. ± 1.5. Sticky. Ignitible by candle flame, and burning with light. *A.* In limestone, marl, clay, sandstone.
Hex. *H.* r'dl., thin tab. *S.* masv., lamellar, coating, powdery.	*Cl.* 0 and I observable. *Fr.* compact, fine and small-grained, stalky.	Cu S	G. 4. Crystals very rare. Ignitible in candle flame and burning with blue flame. (BB, see CHALCOCITE, I. 4.) *A.* Chalcopyrite, Pyrite.
Amorphous. *S.* massive.	*Fr.* conchoidal to plane, compact, slaty, fibr.	C, H, O with ash	G. 1.4–1.6. Ignitible by a candle, and burning with light. *A.* Pyrite.
Amorphous. *S.* massive.	*Fr.* conchoidal, compact	C with little H, O, etc., and ash	G. ± 1.7. Not ignitible by candle flame. Hard to ignite and burning with little or no flame. *A.* Slate, Pyrite.
O'rhm.	*Cl.* I perfect	Cu_3AsS_4	G. 4.4.
Isom. *H.* octdl., hxdl., tetrdl., dodecl. *S.* masv., intsp., reniform, spheroidal.	*Cl.* I highly perfect. *Fr.* granular, compact, scaly, fibrous.	(Zn,Fe,Mn,Cd)S	G. 4. BB fusible with great difficulty. *Ch.* some varieties reddish brown coating of Cd oxide take a white coat of zinc oxide, yellow hot, and white when cold. *A.* Arsenopyrite, Magnetite, Chalcopyrite, Magnetopyrite, Galenite, Garnet, Pyroxene.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Uraninite† (Uranpecherz)	resinous partly metal.	black	grayish black to brownish black	5.5	brittle
Ilvaite‡ (Lievrite)	resinous to semi-metal.	black	greenish black	5.75	brittle
Columbite‡ (Niobit)	vitreous adamantine metalloid	black	grayish to brownish black	6	brittle
Psilomelane (Hartmanganerz)	sub-metal. to non-metal.: lustre of streak greater	bluish black	black, in part brown	6.25	brittle
Braunite† (Marcellin)	sub-metallic	black	black	6.25	brittle

2. Of

Bog Manganese (Manganschaum, Groroilith, Wad)	glistening	black-brown to blue-black	black-brown	1	sectile
Ozocerite‡ (Erdwachs)	resinous	brown	yellow-brown	1	ductile
Chloropal‡ (Fettbol, Gramenit, Pinguit, Nontronit)	resinous	liver-brown	liver-brown	1.75	sectile

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Isom. *H.* octdl. *S.* masv., interspersed, reniform.	*Fr.* compact, conchoidal to uneven	$(U,Pb_2)_3(UO_6)_2$(?)	G. 6.4.–8. Crystals rare. BB fusible with great difficulty, coloring outer flame green. With borax and mrcrsm. salt, yellow bead in O.F. becoming green in R.F. (Uranium). *A.* Torbernite, Galenite, Chalcopyrite, Chloanthite, Bismuth, Pyrargyrite, Barite, Fluorite, in granite.
O'rhm. *H.* colum., acic. *S.* massive.	*Cl.* ii distinct. *Fr.* stalky.	$Fe_2Ca(Fe.OH)(SiO_4)_2$	G. ± 4. BB infusible. Gelatinizes with HCl. *A.* Amphibole, Pyroxene.
O'rhm. *H.* short colum., short acic., tab. *S.* interspersed.	*Cl.* ii distinct	$Fe(NbO_3)_2$ or $Fe((Nb,Ta)O_3)_2$	G. ± 6. BB infusible. (See I. 5.) *A.* Beryl, in granite.
Amorphous. *S.* reniform, botrydl., masv.	*Fr.* conchoidal to uneven	Principally Manganate of Manganese. Much of latter replaced by Ba. Some Ca, Mg, Cu, Al, Fe, and alkalies with H_2O.	G. ± 4. Surface of nodules generally smooth. BB infusible; loses O. Yields Cl with HCl. *A.* Pyrolusite, Polianite, Limonite, Barite.
Tetrag. *H.* pyramidal. *S.* massive.	*Fr.* uneven, gran., compact	$MnMnO_3$. Contains also some Manganese Silicate.	G. ± 4.7. Crystals small. Evolves Cl with HCl. BB infusible. With borax and mrcrsm. salt, amethyst. bead in O.F. becoming colorless in R.F. *A.* Pyrolusite, Psilomelane, Hausmannite, Barite.

Brown Streak.

Amorphous. *S.* reniform, botrydl., masv.	*Fr.* uneven, earthy	Mostly MnO_2 with MnO and 5 to 14 p. c. of H_2O. Contains limonite, calcite, and other subst'ncs	G. ± 3.7. Opaque. Greasy to touch. BB infusible. (See PSILOMELANE, II. 1.) *A.* Psilomelane, Pyrolusite, Limonite, Siderite.
Amorphous. *S.* massive.	*Fr.* compact, fibrous	Hydrocarbon of Methane series of high boiling-point.	G. 0.95. Aromatic odor. Sticky. Inflammable with bright flame. *A.* Bituminous coal, bituminous clay slate.
Amorphous. *S.* massive, earthy.	*Fr.* conchoidal, earthy	$(Fe,Al)_2(SiO_3)_3.5H_2O$	G. 1.7. Opaque. Greasy feel. BB yields water. Infusible, but blackens and becomes magnetic. Partially decomposed by HCl. *A.* Barite, Fluorite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Asphaltum‡ (Erdpech) (See II. 1)	resinous	black to brown	brownish black	2	sectile to brittle
Plattnerite (Schwerbleierz)	metallic adamantine	iron-black	brown	.....	brittle
Lignite (Braunkohle)	resinous	brown to black	brown, partly black	2.5	sect., partly brittle
Chrysocolla (Kieselkupfer)	vitreous, resinous, earthy	green (brown or black when impure)	greenish brown	3.5	brittle
Siderite (Eisenspath)	vitreous **O** pearly	pale yellow, yellow-brown	yellowish brown	4	brittle
Sphalerite (Blende) (See II. 1)	vitreous to adamantine	black to brown	black-brown pink-brown light brown	4	brittle
Göthite (Lepidocrocite)	adamantine, velvety, silky	brown	yellowish brown	4.5	brittle
Wolframite† (Hübnerite)	sub-metallic and adamantine	black	red-brown black-brown	5	brittle
Limonite (Brauneisenerz)	non-metallic	brown	yellow-brown	5.5	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Amorphous	*Fr.* conchoidal	$C_{14}H_{18}O$	G. 1.5.
Hex. *H.* column. *S.* coating, pseudomorphs.	*Fr.* uneven	PbO_2	G. 9.4.
Amorphous. *S.* massive.	*Fr.* earthy, compact, fibr.	More or less carburized vegetable matter containing C, H, O, N, S, and ash	G. ± 1.4. Opaque. Inflammable in the candle flame, and burning with light. *A.* Pyrite, Marcasite, Sulphur, Gypsum.
Amorphous. *S.* masv., intsp., reniform.	*Fr.* conchoidal, compact, earthy	$CuSiO_3.2H_2O$, often with some Al silicate	G. 2.1. Opaque. Closed tube, blackens and gives water. BB decrepitates, and colors flame green. Infusible. Frequent in cap rock. *A.* Malachite, Chalcopyrite, Chalcocite, Cuprite.
Hex. *H.* r'dl., obtuse and acute R, scalenohdrl. *S.* masv., reniform, warty, nodular, lamel.	*Cl.* R 107° perfect, partly curved faces. *Fr.* granular, shelly, compact.	$FeCO_3$. Contains often Mg, Mn, and Ca.	G. 3.8. Brown by weathering. In closed tube decrepitates and becomes magnetic. BB infusible. Blackens. By exposure it darkens. Effervesces in weak acid. *A.* Galenite, Blende, Chalcopyrite, Tetrahedrite, Linnæite, Cinnabar, Barite, Fluorite.
Isom.	*Cl.* I perfect	Zn S (impurities Fe and Cd)	G. 4. BB fusible with difficulty. *A.* Arsenopyrite, Chalcopyrite, Magnetopyrite, Pyrite, Galenite, Siderite, Barite, Garnet, Pyroxene, Magnetite.
O'rhm. *H.* acic., scaly. *S.* masv., reniform.	*Cl.* i ĭ nearly perfect. *Fr.* thin stalky, scaly.	FeO.OH	G. 4. Opaque. Gives off water and is converted to sesquioxide in closed tube. Surface of mass botryoidal. BB infusible. Reactions for iron. *A.* Limonite, Hematite, Specularite.
Mcl. *H.* short colum., thick tab., splintery, acic. *S.* masv., intsp.	*Cl.* i ĭ perfect. *Fr.* thin stalky	$(Fe,Mn)WO_4$	G. ± 7.2. BB fuses easily to magnetic button, which has a crystalline surface. With mercsm. salt, reddish yellow glass while hot. On *ch.* with tin on cooling green, which becomes reddish yellow in continued R.F. *A.* Arsenopyrite, Molybdenite, Cassiterite, Bismuth, Fluorite, Apatite.
Crystalline. *S.* reniform, globular, masv., intsp., powdery.	*Fr.* fibr., stalky, earthy, shelly, compact.	$Fe_4O_3(OH)_6$	G. 4. Often tarnished black. (BB, *A.*, etc., see GÖTHITE, II. 2.)

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Braunite (Marcellin) (See II. 1)	sub-metallic	black	dark brown	6.25	brittle
Psilomelane† (Hartmanganerz) (See II. 1)	non-metallic to sub-metal.	black	dark brown	6.25	brittle
Rutile†	metalloid adamantine	black-brown	light brown, partly yellow	6.5	brittle
Cassiterite† (Zinnerz)	metalloid resinous	black-brown	light brown	6.5	brittle

3. Of

Kermesite‡ (Rothspiessglaserz, Rothspiessglanzerz, Antimonblende, Pyrostibite)	adamantine satin like	dark bluish red to cherry-red	dark bluish red	1	sectile
Cinnabar (Zinnober)	adamantine	cochineal-red	scarlet	2.25	sectile
Pyrostilpnite‡ (Feuerblende, Pyrichrotit)	adamantine, on il pearly	yellowish red to hyacinth-red	auroral red	2.5	sectile to brittle
Erythrite† (Kobaltblüthe)	vitreous il mother-of-pearl	crimson- and peach-red, sometimes pearl- or green-gray	paler than color, dry powder deep lavender-blue	2.5	sectile to brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS, Sp. Gr., Reactions, *A* = Associated Minerals.
Tetrag.	*Fr.* uneven	$MnMnO_3$	G. 4.7. BB manganese reactions with the fluxes. *A.* Pyrolusite, Psilomelane, Hausmannite, Barite.
Amorphous	*Fr.* conchoidal	Manganese Manganate	G. 4.
Tetrag. *H.* colum., acic. *S.* masv., interspersed.	*Cl.* ii perfect, I distinct. *Fr.* compact.	$TiTiO_4$	G. 4. Opaque. BB infusible. With mercsm. salt a colorless bead, which, in R.F., becomes violet on cooling. *A.* Menaccanite (Titanic iron ore), Titanite, Apatite.
Tetrag. *H.* colum., acic., pyramidal. *S.* masv., intsp., rounded.	*Cl.* ii perfect, I distinct.	$SnSnO_4$	G. 6.8. Opaque. BB infusible. On *ch.* with soda, button of metallic tin and white coat. *A.* Arsenopyrite, Wolframite, Scheelite, Molybdenite, Bismuth, Blende, Fluorite, Apatite, Lepidolite.

Red Streak.

Mcl. *H.* capillary. *S.* tufted.	*Cl.* 0 distinct. *Fr.* fibr., stellate.	Sb_2S_2O	G. 4.5. Melts in candle flame. Thin leaves, flexible. Closed tube, blackens, and gives first white and then dark-red sublimate. *A.* Antimonite, Berthierite, Cervantite (Antimonoker), Valentinite.
Hex. *H.* r'dl., thick tab., short colum., short acic. *S.* masv., intsp., coating.	*Cl.* I very perfect. *Fr.* gran., compact, fibrous, earthy.	HgS	G. 9. Sublimes in matrass. Open tube, S fumes and metal. mercury in drops on cold wall of tube. BB volatile. *A.* Hermesite, Mercury, Chalcopyrite, Siderite, Barite.
Mcl. *H.* splintery.	*Cl.* i i perfect	Ag_3SbS_3	G. 4.25. Melts in candle flame. BB, like Pyrargyrite (see below). A. Pyrargyrite.
Mcl. *H.* splintery, acic. *S.* warty, coating.	*Cl.* i i highly perfect. *Fr.* fibr., thin stalky, earthy.	$Co_3(AsO_4)_2.8H_2O$	G. ± 3. BB *ch.* arsenic odor; borax, cobalt glass. *A.* Smaltite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Proustite (Lichtes Roth-giltigerz)	adamantine	cochineal-red auroral red	auroral to scarlet	2.75	sectile to brittle
Pyrargyrite (Dunkles Roth-giltigerz)	metallic adamantine	black, sometimes approaching cochineal-red	cochineal-red cherry-red purple-red	3	sectile to brittle
Chrysocolla (Kieselkupfer) (See II. 2)	resinous or vitreous to earthy	brown to brownish black; when pure, mountain-green to sky-blue	brownish red; when pure, white	3.5	brittle
Zincite† (Rothzinkerz)	sub-adamantine	deep red to orange-yellow	brownish yellow to orange-yellow	4	brittle
Cuprite† (Rothkupfererz)	adamantine sub-metallic	cochineal to dark red	brownish red to blood-red	4	brittle
Hauerite‡ (Mangankies)	sub-metallic	dark reddish brown	brownish red	4	brittle
Hematite (Rotheisenerz, Eisenglanz) (See I. 5)	earthy to sub-metallic	dark red to steel-gray	blood-red	5.5	brittle
Columbite (Niobite)	metalloid-adamantine, vitreous	brownish black	brownish red	6	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Hex. *H.* r'dl., dart-like, acic., colum., thick tab. *S.* masv., intsp., coating.	*Cl.* R, rather distinct. *Fr.* compact.	Ag_3AsS_3	G. 5.42. Melts in candle flame. BB *ch.* odor of SO_2 and As. With soda, silver button. *A.* Argentite, Stephanite, Silver, Arsenic, Smaltite, Chloanthite, Niccolite, Galenite, Barite, Fluorite, Siderite, Pyrite, Marcasite.
Hex. *H.* r'dl., dart-like, acic., colum., thick tab. *S.* masv., intsp., coating.	*Cl.* R, rather distinct	Ag_3SbS_3	G. ± 5.8. Melts in candle flame. BB *ch.* fuses with spirting to globule. Coats coal white. With soda, button of silver. *A.* Same as Proustite, above.
Amorphous	*Fr.* conchoidal, compact, earthy	$CuSiO_3 2H_2O$	G. 2.1. In closed tube yields water. BB decrepitates and colors flame green. With fluxes, reaction for copper. Infusible. *A.* Malachite, etc.
Hex. *H.* hemimorphic. *S.* masv., intsp.	*Cl.* 0 eminent, ii sometimes. *Fr.* coarse gran., thick shelly.	$(Zn,Mn)O$	G. ± 5.5. Heated in closed tube, blackens, but resumes color on cooling. BB infusible. With fluxes on plat. wire, Mn reaction. R.F. coat of ZnO, yellow hot, white on cooling. Soluble in acids without effervescence. *A.* Franklinite, Calcite, Willemite.
Isom. *H.* octdl., hxdl., dodecl., capil. *S.* masv., interspersed.	*Cl.* 1 distinct	Cu_2O	G. ± 6. BB colors flame green; moistened with HCl, blue. With difficulty fusible. *A.* Malachite, Copper, Limonite.
Isom. *H.* octdl.	*Cl.* cubic, distinct	MnS_2	G. 3.4. Closed tube, subl. of S. Open tube, emits S fumes and becomes green. BB infusible. Mn reaction with fluxes. *A.* Sulphur, Gypsum, Tetradymite.
Hex. *H.* r'dl.	*Fr.* compact, fibr., stalky, round gran., earthy	Fe_2O_3	G. ± 5. BB infusible. *Ch.* R.F. becomes magnetic. *A.* Limonite, Göthite, Pyrolusite, Psilomelane.
O'rhm. *H.* thick tab., acic., short columnar.	*Cl.* i–ĭ distinct	$Fe((Nb,Ta)O_3)_2$	G. 6. BB infusible. *A.* Beryl, in granite.

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4. Of

NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Chloropal (Pinguite, Gramenite, Nontronite very similar)	resinous	liver-brown	liver-brown	1	malleable to sectile
Torbernite‡ (Kupferuranit, Uranglimmer in part)	O pearly, otherwise vitreous	emerald-green	pale green apple-green	2	brittle to sectile
Iodyrite (Iodsilber)	adamantine to resinous	sulphur-yellow	light yellow	2	malleable to sectile
Humboldtine‡ (Oxalite)	lustreless to glinting	ochre-yellow to straw-yellow	straw-yellow	2	sectile
Copiapite‡ (Misy)	earthy to glinting	sulphur-yellow	light yellow	2	sectile
Realgar†	resinous to adamantine	auroral red	orange-yellow	2	sectile to brittle
Orpiment†	pearly on cleavage surfaces, elsewhere resinous	lemon-yellow	lemon-yellow	2	sectile

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Yellow Streak.

CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Amorphous. *S.* massive.	*Fr.* compact	$(Fe,Al)_2(SiO_3)_3.5H_2O$ (Nontronite— $Fe_2(SiO_3)_3.5H_2O$)	G. 1.75. Greasy to touch. *A.* Barite.
Tetrag. *H.* scaly, tab., pyr. *S.* coating.	*Cl.* **0** perfect I distinct	$(UO_2)_2Cu(PO_4)_2.8H_2O$	G. 3.5. In closed tube yields water. In forceps fuses to blackish mass and colors flame green. With mercsm. salt fuses to green bead, and with tin on coal cools to opaque red. *A.* Uraninite, Limonite, Hematite.
Hex. *H.* hemimorphic, thin tab., short prsm. *S.* coating, lamel., intersp.	*Cl.* **0** perfect. *Fr.* scaly.	AgI	G. 5.6. Crystals small and rare. Melts in candle flame. *A.* Chlorargyrite, Silver.
Crystalline. *H.* capillary. *S.* massive, coating.	*Fr.* compact, earthy	$(FeC_2O_4)_2.3H_2O$	G. ± 2.2. BB infusible. Closed tube, turns black, loses water, and becomes magnetic. *A.* Gypsum, Alum, Lignite.
Mcl. *H.* scaly. *S.* massive, coating.	*Cl.* perfect in one direction. *Fr.* scaly, earthy.	$(FeOH)_2Fe_2(SO_4)_5.$ $18H_2O$	G. 2.1. Insoluble in water. BB yields water, and at higher temp. sulphuric acid. On *ch.* becomes magnetic. *A.* Pyrite, of which it is a product of decomposition.
Mcl. *H.* short prsm., thick tab., short acic. *S.* masv., intsp., coating.	*Cl.* ii **0** rather perfect. *Fr.* compact, earthy.	As_2S_2	G. 3.4–3.6. Melts in candle flame. Combustible. BB burns with blue flame and arsenic odor. In closed tube, red sublimate. *A.* Arsenic, Antimonite, Pyrite, Orpiment, Barite, Calcite.
O'rhm. *H.* short colmn., lenticular. *S.* masv., intsp., lamel., rounded.	*Cl.* ii perfect. *Fr.* short stellate, scaly, gran., compact.	As_2S_3	G. 3.48. In closed tube yellow sublimate, otherwise like Realgar. *A.* Antimonite, Pyrite, Barite, Calcite, Clay.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Sulphur	resinous to adamantine	sulphur-yellow to gray-brown and red	sulphur- to straw-yellow	2	brittle to sectile
Autunite† (Kalkuranit, Uranit)	**0** pearly, otherwise sub-adamantine	citron- to sulphur-yellow	yellowish	2	sectile
Minium (Mennige)	faint greasy or dull	bright red	orange-yellow	2.5	.....
Xanthoconite‡	adamantine to pearly	orange-yellow	orange-yellow	2.5	sectile to brittle
Crocoite‡ (Rothbleierz, Kallochrom)	vitreous to adamantine	hyacinth to auroral red	orange-yellow	2.75	sectile
Gummite‡ (Gummierz, Uranogummit, Urangummierz)	greasy	reddish yellow, reddish brown	lemon- to orange-yellow	2.75	sectile to brittle
Pharmacosiderite† (Würfelerz)	vitreous	olive-green to yellowish brown	yellow	2.75	rather sectile
Volborthite (Kalkvolborthite)	mother-of-pearl on **0**, otherwise non-metallic	siskin-green	sulphur-yellow to siskin-yellow	3	.....
Pitticite‡ (Arseneisensinter)	vitreous to greasy	yellowish and reddish brown	ochre-yellow	3	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *H.* pyramidal. *S.* masv., intsp., powdery, lamellar, rounded.	*Cl.* I distinct 1 distinct. *Fr.* compact, earthy, fibrous.	S	G. 2.072. BB burns with a blue flame. Melts in candle flame. Sublimes. *A.* Gypsum, Calcite, Coal, Galenite, Celestine.
O'rhm. *H.* scaly, thin tab.	*Cl.* 0 eminent I perfect	$(UO_2)_2Ca(PO_4)_2.8H_2O$	G. ± 3.12. Crystals seem tetragonal. In closed tube yields water. BB fuses at 2.5 to a blackened mass. *A.* Uraninite.
(?) *S.* powdery	.....	Pb_3O_4	G. 4.6. BB *ch.* in R.F., button of metallic lead. *A.* Galenite, Calamine, Cerussite.
Hex. *H.* r'dl., tab. *S.* interspersed, spherical.	*Cl.* in one direction	Ag_3AsS_4	G. 5.1. Melts in candle flame. In closed tube at gentle heat yellow color is changed to red and restored on cooling. *A.* Proustite, Barite.
Mcl. *H.* short colmn., acic., dart-like.	*Cl.* I tolerably distinct	$PbCrO_4$	G. ± 6. In closed tube, blackens; on coal, is reduced to metallic lead with deflagration. *A.* Galenite, Gold, Vauquelinite.
(?) *S.* masv., intsp., reniform.	*Fr.* conchoidal to uneven	$(Pb,Ca,Ba)SiU_3O_{12}.5H_2O$	G. ± 4.1. BB infusible. *A.* Uraninite.
Isom. *H.* hxhdrl.	*Cl.* 0 distinct	$Fe(FeOH)_3(AsO_4)_3.6H_2O$	G. ± 3. Pyroelectric. BB *ch.*, with soda, magnetic mass. Color of powder changed to reddish brown by sol. of caustic potash. *A.* Arsenopyrite, Scorodite.
(?) *S.* scaly.	*Cl.* perfect in one direction	$(Cu,Ca)(CuOH)VO_4$	G. 3.5. BB infusible. Powder mixed with soda and fused, then boiled with water, acidified with HCl, and boiled down, becomes emerald-green; diluted with water, sky blue. *A.* Pyrolusite, Sandstone.
Amorphous. *S.* massive, rounded.	*Fr.* conchoidal	$Fe_{20}(OH)_{24}(SO_4)_3((As,P)O_4)_{10}.9H_2O$	G. 2.3. Often crackled. Fragile. (BB, see PHARMACOSIDERITE, above.) *A.* Arsenopyrite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Vanadinite	greasy	yellow-brown	light yellow	3	brittle
Diadochite‡ (Phosphoreisen-sinter)	resinous to vitreous	yellow to yellow-brown	pale yellowish	3	brittle
Greenockite†	adamantine to greasy	honey-yellow to orange	orange-yellow	3	brittle
Jarosite‡ (Gelbeisenerz)	vitreous, almost to mother-of-pearl	brown	ochre-yellow	3.5	brittle
Cacoxenite‡	silky	ochre- to lemon-yellow (stains brown)	straw-yellow	3.5	brittle
Pucherite	adamantine	reddish brown brownish red	ochre-yellow	4	brittle
Sphalerite, Zinc Blende, or **Blende**	adamantine	brown to reddish brown	straw-yellow, Isabella-yellow, partly brownish	4	brittle
Wurtzite (Strahlenblende)	adamantine to mother-of-pearl	brown	brownish yellow	4	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Hex. *H.* short colmn., short acic.	.....	$Pb_5Cl(VO_4)_3$	G. 6.75. BB fuses easily to lustrous mass. *A.* Galenite; on limestone.
Mcl. *S.* reniform or stalactitic, scaly.	*Fr.* conchoidal	$Fe_4O(OH)_2(PO_4)_2(HSO_4)_2$	G. 2. BB yields much water in closed tube. Swells up and becomes opaque-yellow. In forceps swells up and falls to powder. Carefully heated, fuses to gray-black slag. Fragile. *A.* Alum slate.
Hex. *H.* r'dl., pyr., tab. *S.* small reniform, coating, powdery.	*Cl.* I distinct 0 imperf.	CdS	G. 4.8. Nearly transparent. Strong double refraction. Veined parallel to axis. BB gives SO_2 on coal and brown-red coat. Closed tube, carmine color, fading to original color on cooling. Infus. *A.* Galenite, Blende, Prehnite, Calcite.
Hex. *H.* tabular. *S.* massive.	*Cl.* 0 distinct. *Fr.* scaly.	$(FeO)_3K(SO_4)_2.3H_2O$	G. 3.25. BB intumesces, and in R.F. fuses to magnet. button. Powder turned brownish red by solution of potash. *A.* Hematite, Limonite.
Mcl. or Trcl. *H.* capillary. *S.* massive.	*Fr.* short fibr.	$(Fe_2(OH)_3PO_4)_2.9H_2O$	G. $\pm$ 3.4. BB closed tube yields water. Fusible on edges to black slag. Colors outer flame bluish green. *A.* Limonite, Dufrenite.
O'rhm. *H.* tab., short acic.	*Cl.* I distinct	$BiVO_4$	G. 5.9. BB *ch.*, fused with S and KI, red sublimate. With mercsm. salt in R.F., green bead. *A.* Bismuthite.
Isom. *H.* octdl., tetrdl., dodecl. *S.* masv., intsp., reniform.	*Cl.* I. *Fr* gran., thin stalky, shelly, fibr., compact.	ZnS (contains often Fe and Cd, Cu, Sb, and Mn)	G. 4. Very hard to fuse. BB, open tube. SO_2. On coal, coating of Zn and sometimes of Cd. *A.* Galenite, Chalcopyrite, Pyrite, Arsenopyrite, Siderite, Barite, Fluorite.
Hex. *H.* r'dl., tab. *S.* massive, rounded.	*Cl.* I distinct 0 less so. *Fr.* fibrous.	(Zn,Fe)S	G. 4. (BB, see SPHALERITE.) *A.* Blende, Galenite, Siderite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Zincite† (Rothzinkerz)	sub-adamantine	orange-yellow	orange-yellow	4	brittle
Triplite	resinous	brown-black	pale yellow gray-yellow	4.5	brittle
Göthite (Nadeleisenerz)	adamantine velvety silky	brown	brownish yellow	4.5	brittle
Limonite	greasy to vitreous, also silky	brown-yellow	brown-yellow to ochre-yellow	5.5	brittle
Basaltic Hornblende‡	vitreous	brown-black to pitch-black	Isabella-yellow to ochre-yellow	5.5	brittle
Rutile (See II. 2)	metalloid adamantine	black-brown	light yellow	6.5	brittle
Cassiterite (Zinnerz)	adamantine, slightly metallic	brown to black	Isabella-yellow	6.5	brittle
Ferruginous Quartz	vitreous	ochre-yellow to brown	light ochre-yellow	7	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Hex. *H.* hemimrph. *S.* masv., interspersed.	*Cl.* 0 eminent ii sometimes. *Fr.* coarse gran., thick shelly.	(Zn,Mn)O	G. ± 5.5. BB infusible. *A.* Franklinite, Calcite, Willemite.
Mcl. *S.* massive.	*Cl.* distinct in two directions. *Fr.* thick shelly.	$(Fe,Mn)PO_4(Fe,Mn)F$	G. 4. Fuses easily to black magnetic globule. With H_2SO_4 evolves F. Soluble in HCl. *A.* Apatite, Beryl. In granite.
O'rhm. *H.* acic., scaly, capillary. *S.* massive, rounded.	*Cl.* ii perfect. *Fr.* fibrous, stalky, scaly.	FeO.OH	G. 4. BB iron reactions. *A.* Limonite.
Crystalline. *S.* masv., interspersed, reniform, rounded, powdery.	*Fr.* stalky, fibr., earthy, shelly, compact	$Fe_4O_3(OH)_6$	G. ± 3.7. BB iron reactions. *A.* Hematite, Pyrolusite, Psilomelane, Barite, Chalcedony.
Mcl. *H.* prsm., acic. *S.* masv., intsp.	*Cl.* I highly perfect. *Fr.* compact, stalky.	$(Mg,Fe)_2Al_2(AlO_3)_2(SiO_3)_2$	G. ± 3.1. Unacted on by acids. *A.* Augite in Basalt, Phonolite, etc.
Tetrag. *H.* pyr., colmn., acic. *S.* masv., intsp.	*Cl.* ii perfect I distinct. *Fr.* thick gran.	$TiTiO_4$	G. 4. (BB, see II. 2.)
Tetrag. *H.* colmn., acic., pyr. *S.* masv., intsp.	*Cl.* ii perfect I distinct. *Fr.* compact, fibrous, gran.	$SnSnO_4$	G. ± 6.8. Opaque. BB infusible. Coal with soda metallic tin. *A.* Arsenopyrite, Wolframite, Molybdenite, Bismuth, Fluorite, Apatite, Scheelite, Lepidolite, Blende, Chalcopyrite, Pyroxene, Amphibole.
Hex. *H.* colmn., acic. *S.* masv., intsp.	*Fr.* compact, gran., stalky	SiO_2 (with yellow or red oxide of iron)	G. 2.7. BB infusible. Borax dissolves slowly to clear glass-green when hot. Melts with soda with intumescence. *A.* Limonite.

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5. Of

NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Chloropal‡ (Pinguite, Nontronite very similar)	waxy	finch-green	yellowish green to finch-green	1	sectile to malleable
Bromargyrite (Bromsilber, Embolite, Chlorbromsilber)	adamantine	green yellow	yellowish to siskin green	1.5	malleable
Ehlite‡ (Prasin in part)	common, mother-of-pearl	emerald-green	pale green	2	sectile to brittle
Torbernite† (Kupferuranit) (See II. 4)	common on **0**, mother-of-pearl	emerald-green, verdigris-green, apple-green	pale green apple-green	2	brittle to sectile
Genthite‡ (Nickel Sepiolith)	feebly resinous to lustreless	apple-green to emerald-green	pale green apple-green	2	sectile
Annabergite† (Nickelblüthe)	glinting to lustreless	apple-green	pale green apple-green	2.25	sectile to brittle
Garnierite‡ (Numäit)	glinting to lustreless	apple-green	pale green	2.5	brittle

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Green Streak.

CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Amorphous. *S.* massive.	*Fr.* on large surfaces conchoidal to uneven, on small surfaces splintery, earthy	$(Fe,Al)_2(SiO_3)_3.5H_2O$	G. ± 1.8. Greasy feel. Closed tube yields water. BB infusible, turns black, and becomes magnetic. Completely decomp. by HCl with separation of pulverulent SiO_2. *A.* Barite.
Isom. *H.* hexdl, octdl. *S.* massive, lamel., coating.	*Fr.* massive, splintery	Ag Br	G. 5.9. Often gray tarnish. Melts in candle flame. In closed tube fuses without decomp. Placed on strip of zinc and moistened swells up, turns black, and is reduced to metallic Ag. which gives lustre on pressure with knife-blade. *A.* Native Silver, Calcite.
Crystalline. *H.* scaly. *S.* masv., intsp., reniform, warty.	*Cl.* perfect in one direction. *Fr.* scaly, radial.	$Cu(CuOH)_4(PO_4)_2H_2O$	G. 4. In matrass gives water and turns black. Heated rapidly decrepit. BB *ch.* long heated fuses to button with nucleus of Cu. *A.* Pseudomalachite.
Tetrag. *H.* scaly, tab., pyramidal.	*Cl.* **0** perfect i distinct	$(UO_2)_2Cu(PO_4)_2.8H_2O$	G. ± 3.5. In closed tube yields water. In forceps fuses to black mass and colors flame green. *A.* Uraninite, Limonite, Hematite.
Amorphous. *S.* coating.	*Fr.* conchoidal	$(Mg,Ni)_2H_4Si_2O_{10}$	G. 2.4. Sometimes so soft as to be polished by the nail and fall to pieces in water. Closed tube, blackens and gives water. BB almost infusible. *A.* Chromite, Serpentine.
Mcl. *H.* capillary. *S.* masv., intsp., coating.	*Fr.* compact, earthy	$(Ni_3(AsO_4)_2.8H_2O$	G. 3. BB fuses easily, with arsenic odor, and yields metallic button, which with borax gives first blue cobalt glass, and later violet to reddish brown of Ni. *A.* Chloanthite, Niccolite, Gersdorffite, Siderite, Barite.
Amorphous	*Fr.* massive	$(Ni,Mg)H_2SiO_4$	G. 2.27. Adheres to tongue. In matrass gives water, becoming gray. With borax, nickel bead. Immersion in water, decrepitates, the fragments having conchoidal fracture. *A.* Chromite, Serpentine, Steatite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Ripidolite† (Chlorite Group)	of cleavage face somewhat pearly	deep grass-green to olive-green	gray-green to uncolored	2.5	sectile
Cronstedtite‡ (Chamosit)	vitreous	coal-black to brownish black	dark olive green	2.5	brittle
Tyrolite‡ (Kupferschaum)	0 pearly	bluish green	bluish, verdigris green	2.5	sectile
Chalcophyllite‡ (Kupferglimmer)	0 pearly	emerald- to verdigris-green	pale green	2.5	brittle
Clinoclasite‡ (Strahlerz)	0 pearly	bluish green to greenish black, on surface nearly black	bluish green	2.75	sectile to brittle
Liroconite‡ (Linsenerz)	vitreous to greasy	bluish green	bluish green	2.75	brittle to sectile
Euchroite‡	vitreous	emerald-green	bluish green	3	brittle
Dufrenite† (Kraurite, Grüneisenerz)	vitreous to greasy, on ii pearly	dark leek-green to greenish black	yellowish green siskin-green	3.25	very brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Mcl. *H.* tab., foliaceous, scaly. *S.* masv., intsp., reniform, coating.	*Cl.* **0** eminent. *Fr.* scaly, compact, earthy.	$Al_2(Fe,Mg)_5H_9Si_3O_{20}$	G. ± 2.7 Crystals seem hex. BB yields water. In platinum forceps whitens, and fuses with difficulty on edges. Partially gelatinizes with acids. *A.* Talc, Dolomite, Magnetite.
Hex. *H.* r'drl., colmn., fibr. *S.* masv., reniform, cylindrl.	*Cl.* **0** highly perfect	$Fe_2(Fe,Mg)_3H_6Si_2O_{13}$	G. ± 3.3. BB froths and fuses on edges. Gelatinizes in concen. HCl. *A.* Limonite, Calcite.
(?) *H.* foliaceous, scaly. *S.* massive.	*Cl.* perfect in one direction. *Fr.* scaly, radial.	$Cu(CuOH)_4(AsO_4)_2 \cdot 7H_2O$	G. 3. In closed tube decrepitates and yields much water. *Ch.* fuses with arsenic odor. R.F. globules of copper. *A.* Tetrahedrite, Malachite, Azurite.
Hex. *H.* r'drl., scaly, foliaceous, thin tab.	*Cl.* **0** highly perfect	$(Cu(OH)_2(CuOH)_3 AsO_4)_2 7H_2O$	G. ± 2.5. In closed tube decrepitates and yields much water. Soluble in ammonia. *A.* Chalcopyrite, Cuprite.
Mcl. *H.* short acic., short colmn., thick tab., chisel-shaped. *S.* rounded.	*Cl.* **0** perfect crumpled, foliaceous. *Fr.* radial.	$(CuOH_3)AsO_4$	G. ± 4.2. In closed tube gives water. BB fuses, coloring flame bluish green. *Ch.* with soda, button of copper. Soluble in ammonia. *A.* Chalcopyrite.
Mcl. *H.* short colmn., blunt pyram., lenticular.	.....	$(Al_4Cu_9(OH)_{15}(AsO_4)_5 \cdot 20H_2O$	G. 2.8. In closed tube gives much water and turns green. BB cracks open, but does not decrepitate. Sol. in ammonia. *A.* Chalcopyrite.
O'rhm. *H.* thick tab., short columnar.	*Cl.* I rather distinct	$(CuOH)CuAsO_4 3H_2O$	G. ± 3.4. In closed tube gives water. (For other reactions, see OLIVENITE.) *A.* Olivenite, Asbolite.
O'rhm. *H.* cuboid. *S.* reniform.	*Cl.* ii perfect. *Fr.* radial.	$Fe_3(OH)_3PO_4$	G. ± 3.3. In closed tube gives water. BB fuses easily to slag. Crystals rare and small. *A.* Limonite, Cacoxenite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Zaratite† (Emerald Nickel, Nickel Smaragd)	vitreous	emerald-green	paler green	3.25	brittle
Chrysocolla (Kieselkupfererz)	vitreous, unctuous to lustreless	green	bluish green	3.5	brittle
Libethenite† (Prasin)	greasy to vitreous	leek-green to blackish green	olive-green to bright green	3.5	brittle
Olivenite† (Pharmakochalzit)	vitreous unctuous silky	leek-green olive-green pistachio-green	olive-green	3.5	brittle
Malachite	vitreous, pearly, and silky	emerald-green, on **0** greenish black	emerald- to verdigris-green	3.5	brittle
Brochantite‡	vitreous	emerald-green	emerald- to verdigris-green	3.5	brittle
Alabandite‡ (Manganblende)	sub-metallic	iron-black	dark green to gray	3.75	brittle to sectile
Atacamite‡ (Halochalzit)	vitreous to unctuous	emerald- to leek-green	emerald- to light verdigris-green	3.75	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
(?)	.....	$2Ni(OH)_2NiCO_3.4H_2O$	G. 2.57. Stalactitic. Minute mammillary. In closed tube yields water and CO_2. BB infusible. Borax O.F. violet bead hot, and reddish brown cold. R.F. green, opaque. *A.* Chromite, Serpentine.
Amorphous	*Fr.* conchoidal to irregular	$CuSiO_3.2H_2O$	G. 2.1. (See II. 2, 3.)
O'rhm. *H.* pyramidal.	.....	$(CuOH)CuPO_4$	G. 3.7. In closed tube yields water and turns black. BB fuses, colors flame green, and R.F. with soda yields metallic copper. *A.* Malachite, Cuprite, Limonite.
O'rhm. *H.* short acic., short colmn., capillary. *S.* masv., reniform.	*Fr.* fibrous	$(CuOH)CuAsO_4$	G. ± 4.3. In closed tube gives water. BB fuses, coloring flame bluish green, and on cooling fused mass is crystalline. *Ch.* with soda, copper. Soluble in ammonia. *A.* Chalcopyrite, Asbolite, Enargite.
Mcl. *H.* capil., acic. *S.* masv., intsp., reniform, powdery, coating.	*Cl.* **0** perfect ii less so. *Fr.* fibr., compact, earthy, scaly, shelly.	$(CuOH)_2CO_3$	G. ± 3.8. In closed tube blackens and yields water. BB fuses, coloring flame emerald-green. *Ch.* in R.F., reduced to copper. Effervesces with acids. *A.* Chalcopyrite, Tetrahedrite, Chalcosite, Cuprite, Copper, Limonite, Hematite, Azurite.
O'rhm. *H.* short acic. *S.* reniform.	*Cl.* ii very perfect. *Fr.* fibrous.	$2Cu(OH)_2(CuOH)_2SO_4$	G. ± 3.8. Crystals small. In matrass yields water and turns blackish brown. Soluble in NH_3O. BB, mixed with *ch.*, powder gives SO_2. Melts on coal in R.F., yielding button of Cu. *A.* Chalcopyrite, Malachite, Limonite.
Isom. *H.* octahedra.. *S.* masv., intsp.	*Cl.* **0** perfect. *Fr.* compact.	MnS	G. ± 4. Opaque. Surface dull and dark brown. BB fuses with much difficulty. Unchanged in closed tube. With fluxes, reaction for Mn. Soluble in HNO_3 with evolution of H_2S. *A.* Blende, Rhodochrosite.
O'rhm. *H.* acic., prsm., thick tab. *S.* masv., intsp., powdery.	*Cl.* ii distinct **0** distinguishable. *Fr.* radial.	$Cu(OH)_2Cu(OH)Cl$	G. 4.1. In closed tube gives off water. BB azure-blue flame. *Ch.* with soda, metallic Cu. Soluble in ammonia. *A.* Limonite, Hematite.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Dioptase† (Kupfersmaragd)	vitreous	emerald-green	verdigris-green to sky-blue	4.75	brittle
Pseudo-Malachite† (Phosphor-chalcit)	greasy to vitreous	blackish green, emerald-green, verdigris-green	emerald- to verdigris-green	5	brittle
Pyroxene (Augite)	vitreous	blackish green, greenish black	grayish green	5.5	brittle
Hornblende† (Amphibole)	vitreous, in part pearly	blackish green to velvet-black	grayish green	5.5	brittle
Lievrite (Ilvaite)	unctuous	black	dark green	5.75	brittle
Spinel (Var. Pleonast)	vitreous to greasy	black to green	grayish green	7.5	brittle

6. Of

Tyrolite‡ (Kupferschaum)	pearly	sky-blue to verdigris-green	greenish blue	2.5	sectile
Vivianite† (Blaueisenerz)	il metallic pearly, other faces vitreous	indigo-blue to blackish green	light indigo-blue	2.5	sectile

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Hex. *H.* r'drl., short columnar. *S.* interspersed.	*Cl.* R perfect. *Fr.* compact.	CuH_2SiO_4	G. ± 3.2. In closed tube blackens and yields water. BB blackens without fusing, and colors flame emerald-green. Gelatinizes with acids. *A.* Calcite.
(?) *H.* short colmn. *S.* masv., intsp.	*Fr.* compact, fibrous	$(Cu.OH)_3PO_4$	G. ± 4.2. In closed tube yields water and turns black. BB fuses, colors flame green, and with soda on coal gives metallic copper. Sparingly soluble in ammonia. *A.* Malachite.
Mcl. *H.* short colmn., thick tab. *S.* masv., intsp.	*Cl.* I distinct I ∧ I 87°. *Fr.* granular.	$Mg,Ca(SiO_3)_2$	G. 3.3. *A.* Amphibole, Garnet, Calcite, Magnetite, Pyrite, Blende, Galenite.
Mcl. *H.* short colmn., short acic. *S.* masv., intsp.	*Cl.* I perfect i ∧ i 124°. *Fr.* fibr., stalky, granular.	$(Mg,Fe)_3Ca(SiO_3)_4$	G. ± 3.1. *A.* Pyroxene, and same as preceding.
O'rhm. *H.* colmn., acic. *S.* intsp., masv.	*Cl.* i–ĭ distinct. *Fr.* fibrous, stalky.	$(FeOH)Fe_2Ca(SiO_4)_2$	G. 3.9. BB fuses to black magnetic bead. Gelatinizes with HCl. *A.* Pyroxene.
Isom. *H.* octahedral. *S.* intsp., masv.	*Fr.* compact, conchoidal.	$(Mg,Fe)((Al,Fe)O_2)_2$	G. ± 4.2. Opaque. BB infusible. *A.* Magnetite, Calcite, in basalt.

Blue Streak.

(?) *H.* foliaceous, scaly. *S.* massive.	*Cl.* perfect in one direction. *Fr.* scaly, radial.	$(CuOH)_4Cu(AsO_4)_2 + 7H_2O$	G. 3. In closed tube decrepitates and yields much water. *Ch.* fuses with As odor. R.F. with soda, button of copper. Sol. in HCl with effervescence. *A.* Tetrahedrite.
Mcl. *H.* acic., scaly. *S.* masv., intsp., powdery.	*Cl.* ii highly perfect. *Fr.* radial, earthy.	$Fe_3(PO_4)_2.8H_2O$	G ± 2.5. In closed tube yields neutral water, whitens and exfoliates. BB fuses, coloring flame bluish green to gray; black metallic globule. *A.* Limonite, Pyrite, Magnetopyrite, Clay, Peat.

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NAME.	LUSTRE.	COLOR.	STREAK.	HARD'SS.	TENACITY.
Herrengrundite (Urvölgyite)	pearly	emerald-green	sky-blue	2.75	brittle
Liroconite‡ (Linsenerz)	vitreous to greasy	sky-blue to verdigris-green	greenish blue	2.75	brittle to sectile
Linarite‡ (Bleilasur)	adamantine to vitreous	deep azure-blue	pale blue	2.75	brittle
Azurite† (Kupferlasur)	vitreous or adamantine	azure-blue blackish blue smalt-blue	smalt-blue	3.75	brittle
Chrysocolla	vitreous, unctuous to lustreless	sky-blue	smalt-blue	3.5	brittle
Dioptase† (Kupfersmaragd)	vitreous	emerald-green	sky-blue to verdigris-green	4.75	brittle
Lapis Lazuli† (Lasurstein, Lasurite)	greasy to vitreous	azure-blue	smalt-blue to pale blue	5.5	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Mcl. *H.* foliaceous. *S.* massive.	*Cl.* **0** perfect. *Fr.* shelly, scaly.	$Ca(OH)_2(CuOH)_2 2SO_4.3H_2O$	G. 3.1. *A.* Gypsum.
Mcl. *H.* short colmn., blunt pyram., lenticular.	.....	$Al_4Cu_9(OH)_{15}(AsO_4)_5.$ $20H_2O$. Part of P replaced by As.	G. 2.8. In closed tube yields much water and turns green. BB cracks open but does not decrepitate. Soluble in NH_5O. *A.* Tetrahedrite.
Mcl. *H.* acic., tab.	*Cl.* i–ī very perfect 1–ī dist.	$((Pb,Cu)OH)_2SO_4$	G. ± 5.4. In closed tube yields water and loses color. BB fuses easily to a pearl, and in R.F. yields metallic button, which coats *ch.* with PbO. On fusing this with boric acid Cu is obtained. With soda, hepar reaction. Decomposed by HNO_3, leaving white $PbSO_4$. *A.* Chalcopyrite, Galenite, Cerussite.
Mcl. *H.* thick tab., thin tab., acic. *S.* masv., intsp., rounded, coating, powdery.	*Cl.* 2–ī rather perfect ī–i less distinct. *Fr.* radial, compact, earthy.	$(Cu.OH)_2Cu(CO_3)_2$	G. ± 3.7. BB, see MALACHITE, II. 5.
Amorphous	*Fr.* conchoidal to uneven	$CuSiO_3.2H_2O$	G. ± 2.1. (See II. 2.) Decomposed by acids without gelatinizing.
Hex.	*Cl.* R perfect	CuH_2SiO_4	G. ± 3.2. (See II. 5.)
Isom. *H.* dodecdrl. *S.* masv., intsp.	*Fr.* massive, fine-granular	$(Na_2,Ca)AlSiO_4$ (?)	G. ± 2.3. Crystals very rare. In closed tube gives off water, and that from Chili glows with beetle-green light, but color remains blue. Fuses with intumescence to white glass, decomp. by HCl, with separation of gelatinous SiO_2 and evolution of H_2S. *A.* Pyrite, Calcite. *Never Quartz.*

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III. MINERALS OF NON-

AND OF WHITE OR

1. Very

NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Petroleum† (Erdöl, Steinöl)	.....	black, brown, yellow, white	.....	.....
Ozocerite (Mineral wax)	unctuous	brown, yellow	1	malleable waxy
Talc (Steatite)	pearly to greasy	white, light green	1	very sectile to malleable
Kaolinite (Porcelain earth, Nacrite allied)	on **0** pearly lustreless	white	1	sectile
Aluminite†	glinting to dull earthy	white	1	sectile to malleable
Ulexite (Boronatrocalcit)	silky	white	1	.....

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METALLIC LUSTRE

LIGHT GRAY STREAK.

Sectile.

CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
.....	.....	A mixture of the higher members of the Paraffine series C_nH_{2n+2}	G. 0.6 to 0.75. Liquid, saturating sandstones and other sedimentary rocks. Inflammable. Odorous.
(?)	.....	" " "	G. 1. Solid. Strong smell. Waxy. Sticky. Melts in boiling water. Burns with bright flame. *A.* Clay, sandstone, rock salt.
Mcl. (?) *H.* scaly, foliaceous. *S.* massive.	*Cl.* **0** perfect. *Fr.* thin shelly, scaly, compact, splintery.	$Mg_3H_2Si_4O_{12}$	G. ± 2.7. Very greasy to touch. In closed tube, when intensely heated, most varieties yield water. BB fusible on very thin edges to white enamel. With cobalt solution a pale red color. Not decomp. by acids. *A.* Actinolite, Chlorite, Dolomite, Magnesite, Apatite, Magnetite, Pyrite.
Mcl. *H.* scaly. *S.* massive, coating.	*Cl.* **0** perfect. *Fr.* fine scaly, earthy.	$Al_2H_4Si_2O_9$	G. ± 2.5. Opaque. Nacrite greasy, Kaoline chalky feel. Becomes plastic in water. BB infusible. *A.* Galenite, Blende, Siderite, Lignite, Cassiterite.
Mcl. (?)	*Fr.* earthy	$Al_2(OH)_4SO_4.7H_2O$	G. ± 2.6. In closed tube yields much water, which at high temperature becomes acid. With cobalt solution, fine blue color. With soda, hepar reaction. Soluble in acids. BB. infusible. *A.* Clay, Marl, Gypsum.
(?) *S.* in rounded masses, fibr., acic.	.....	$CaNaB_5O_9.6H_2O$	G. 1.6. *A.* Anhydrite, Gypsum.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Smectite† (Malthazite, Montmorillonit)	waxy	greenish gray	1	sectile to malleable
Pyrophyllite‡ (Agalmatolite)	pearly	white, apple-green, yellowish	1.5	sectile
Cerargyrite (Hornsilver, Chlorargyrite, Silberhornerz)	resinous to adamantine	gray, gray-green, brown, streak shining	1.5	malleable
Bromyrite (Bromargyrite, Bromsilber)	adamantine splendent	bright yellow to amber, slightly greenish	1.5	sectile
Embolite	" " "	" " "	"	"
Calomel‡ (Quecksilberhornerz)	adamantine	white, gray, brown	1.5	sectile
Sassolite‡ (Boric acid)	on **0** pearly	white, pale yellow	1.5	sectile
Sal Ammoniac† (Salmiak)	greasy to vitreous	white, yellow	1.75	sectile
Soda Nitre† (Chili Nitre, Natronsalpeter)	vitreous	white	1.75	sect. to brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Amorphous.	*Fr.* conchoidal to uneven, compact, splintery	$Al_2H_2Si_4O_{12} + x\,H_2O$	G. ± 2. Soapy feel. BB Malthazite is infusible, but Smectite, owing to impurities, fuses easily. Decomposed by HCl.
O'rhm. *H.* scaly. *S.* masv., lamel.	*Cl.* **0** eminent. *Fr.* broad stalky, scaly, compact.	$AlH.Si_2O_6$	G. ± 2.8. Very greasy to touch. Yields water. BB whitens and fuses with difficulty on edges. Radial varieties exfoliate and swell up very much. With cobalt solution blue. *A.* Cyanite.
Isom. *H.* hexhdl. *S.* masv., lamel., coating.	*Cl.* none. *Fr.* compact, fibrous.	$AgCl$	G. ± 5.4. Fuses without decrepitation in candle flame. BB on coal, button of metallic silver. In bead of micrcsm. salt, saturated with CuO, gives intensely blue flame. On zinc and moistened with water swells up, turns black, and is reduced to metallic Ag, whose lustre appears on pressing with a knife. Soluble in ammonia. *A.* Native Silver, Calcite, Limonite.
Isom. *H.* hexdl., octdl. *S.* masv., lamel., coating.	*Fr.* compact, fibrous	$AgBr$	G. 5.9. In closed tube and with metal. Zn behaves like Cerargyrite. *A.* Native Silver, Calcite.
" "	" "	Ag_2ClBr	
Tetrag. *H.* pyr., thick tab., short acic. *S.* interspersed, coating.	*Cl.* i–i perfect. *Fr.* compact.	Hg_2Cl_2	G. 6.5. Crystals very small. Sublimes. Volatilizable, giving white sublimate. Blackens with alkalies. *A.* Cinnabar, Mercury.
Trcl. *H.* scaly, capil. *S.* incrusted.	*Cl.* basal very perfect. *Fr.* scaly, fibr.	$(OH)_3B$	G. ± 1.5. Greasy to touch. With difficulty soluble in water. In closed tube gives water. BB fuses on wire to clear bead, and tinges flame yellowish green. *A.* Native Sulphur.
Isom. *H.* trapzhdl., octdl., hexdl. *S.* incrustations and coatings.	*Fr.* fibrous, earthy	NH_4Cl	G. 1.5. Taste astringent. Sublimes in tube. Heated with $Ca(OH)_2$ gives off ammonia. Dissolves readily in water, and solution precipitates HgCl when added to $AgNO_3$ in solution. *A.* Lava, clay, coal.
Hex. *H.* r'dl. *S.* massive.	*Cl.* R perfect. *Fr.* granular.	$NaNO_3$	G. ± 2.1. Taste cooling and bitter. Soluble in water. Deflagrates on coal. Melts in candle flame, which it colors Na yellow. *A.* Halite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Mirabilite‡ (Glauber's Salt, Exanthalit)	vitreous	white	1.75	sectile
Halloysite (Bol. Variety Kaolinite)	resinous	white, yellow, red	2	sect. to brittle
Copalite‡ (Retinite, Rhetinit)	resinous	yellow, brown, gray	2	sect. to brittle
Kalinite† (Alum, Potash Alum)	vitreous	white	1.75	brittle to sectile
Nitre (Saltpeter)	vitreous	white	2	sectile
Chrysotile (Serpentine Asbestos)	metallic, silky	green, brown	2	sect. to brittle
Gypsum	vitreous, silky, il pearly	white, gray, yellow, red, brown	2	sect. to brittle
Melanterite† (Copperas, Green Stone, Iron Vitriol, Green Vitriol)	vitreous	green, effloresces to white	2	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS, Sp. Gr., Reactions. *A* = Associated Minerals.
Mcl. *S.* in efflorescent crusts.	*Cl.* i–i perfect	$Na_2SO_4.10H_2O$	G. 1.5. Cooling taste, then saline and bitter. Fuses. Yields much water. Dissolves easily in water, and solution precipitates $BaCl_2$ solution. Colors flame yellow. *A.* Efflorescence Carlsbad and other thermal springs, caverns Hawaii.
Amorphous. *S.* masv., intsp., lamellar.	*Fr.* compact	$Al_2H_4Si_2O_9.xH_2O$	G. 2.5. Infusible. Blue with Co solution. *A.* Basalt, sandstone.
Amorphous. *S.* masv., intsp., nodular.	*Fr.* compact, earthy	$C_{12}H_{18}O$	G. 1.01. Melts in candle flame. Volatilizes by gentle heat. Burns with yellow flame and much smoke. Emits resinous odor when broken. *A.* Lignite.
Isom. *H.* pentagonal, hmhdrl. *S.* efflorescence.	*Cl.* 1 observable	$KAl(SO_4)_2.12H_2O$	G. 1.75. Soluble in water. Alum taste. BB fuses in its water of crystallization and froths. With Co solution, intense blue, and with soda, hepar reaction. *A.* Lava, coal.
O'rhm. *H.* acic., capil. *S.* flaky, coat'g.	*Cl.* I and ii observable	KNO_3	G. 2. Taste saline and cooling. Deflagrates vividly on burning coals, and detonates with combustibles. Colors flame violet. *A.* Limestone caves.
O'rhm. *S.* lamellar.	*Fr.* fibrous	$(MgFe)_3H_4Si_2O_9$	G. 2.2. Delicately fibrous, the fibres easily separating. *A.* Serpentine.
Mcl. *H.* colmn., acic., tab., scaly, lenticular. *S.* masv., lamellar, powdery.	*Cl.* ī perfect ī and īi observbl., 66°. *Fr.* gran., fibr., scaly, earthy, compact.	$CaSO_4.2H_2O$	G. 2.3. Very little soluble in water. Yields water and becomes opaque. BB melts to a button. *A.* Clay, marl, Native Sulphur, also as new formation on metal veins.
Mcl. *H.* capil., acic., columnar. *S.* reniform, masv., lamellar.	*Cl.* 0 observable. *Fr.* compact, fibrous.	$FeSO_4.7H_2O$	G. 1.8. Dissolves in water. Yields water, and becomes brown and finally black and magnetic. With fluxes, reacts for Fe. Taste harsh, astringent, and metallic. *A.* Alunogen, Pyrite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Alunogen‡ (Keramohalite, Haarsalz)	silky, pearly	white, partly yellowish	2	sectile
Aurichalcite (Cupreous Hydro zincite, Messingblüthe)	pearly	greenish blue bluish green	2	sectile
Brucite†	O pearly	white	2	sectile
Sulphur	adamantine resinous	yellow, gray, brown	2	brittle to sectile
Trona‡ (Natron, Urao)	vitreous	white	2.1	sectile
Sepiolite† (Meerschaum)	dull, brightens in streak	white, partly yellowish	2.25	sectile
Borax† (Tinkal)	resinous to vitreous	white, in part gray	2.25	brittle to sectile
Tschermigite‡ (Ammonia Alum)	vitreous	white	2.25	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
(?) *H.* capil., acic., scaly. *S.* reniform, botrydl., lamel., incrustation	*Cl.* perfect in one direction. *Fr.* fibr., scaly, granular.	$Al_2(SO_4)_3.18H_2O$	G. ± 1.7. Taste astringent. Yields water and SO_2 in closed tube. Blue with Co solution. When deprived of water infusible. *A.* Clay, Lignite, Pyrite, Alum, coal.
(?) *H.* acic., scaly. *S.* drusy incrustations, masv.	*Cl.* perfect in one direction. *Fr.* fibr., scaly.	$2(Zn,Cu)(OH)_2.((Zn,Cu)OH)_2CO_3$	G. 3.7. Soluble with effervescence in hydrochloric acid. *A.* Limonite, Chalcopyrite, Zincblende.
Hex. *H.* r'dl., tab. scaly. *S.* massive.	*Cl.* 0 perfect. *Fr.* shelly, stalky, fibr	$Mg(OH)_2$	G. 2.3. Greasy to touch. Yields water, becoming opaque. BB infusible, but vividly incandescent. With Co solution, violet red. Soluble in acids. *A.* Serpentine, limestone, Chromite.
O'rhm. *H.* pyramidal. *S.* masv., lamel., rounded, crustlike, powdery, interspersed.	*Cl.* 0 / 1 observ.	S	G. 2. Melts and ignites in candle flame. (See II. 4.)
Mcl. *H.* colum., fibr. *S.* massive.	*Cl.* i–i perfect	$Na_2NaH(CO_3)_2.2H_2O$	G. 1.4. Soluble in water. Alkaline reaction and taste. Only occurs in powder. Colors flame intensely yellow. *A.* Mirabilite, Halite.
Amorphous. *S.* massive, nodular.	*Fr.* in large masses, conchoidal; in small, earthy, compact	$Mg_2H_4Si_3O_{10}$	G. 0.988–1.279. Can be cut by the nail. Unctuous to the touch; adhering to the tongue. BB yields water and then burnt odor. Violet-red with Co solution. *A.* Chalcedony, Opal, Chlorite.
Mcl. *H.* short colmn., tabular.	*Cl.* i1 observable	$Na_2B_4O_7.10H_2O$	G. 1.7. Soluble in water. BB puffs up and fuses to a clear bead called borax glass. Fused with fluorspar and $KHSO_4$ colors flame green. *A.* In waters of salt lake of Thibet and in mineral springs of Chambly (Canada East) and Borax Lake, Cal., and the Tuscan lagoons.
Isom. *H.* pentagonal, hmhdrl. *S.* lamellar	*Fr.* fibrous.	$AlNH_4(SO_4)_2.12H_2O$	G. 1.5. Soluble in water. Alum taste. Yields water and sublimes, leaving coat of itself on tube. Melts in flame. Deprived of water, infus. *A.* Clay, Gypsum.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Goslarite‡ (White Vitriol, Zinkvitriol)	vitreous	white, gray	2.25	brittle
Epsomite‡ (Bittersalz)	vitreous	white, pale yellow, pale red	2.25	brittle
Annabergite‡ (Nickelblüthe)	glinting to dull	apple-green	2.25	sectile to brittle
Pharmacolite‡ (Arsenblüthe)	vitreous, pearly, silky	white	2.25	sectile
Senarmontite‡	adamantine resinous	white, gray	2.25	brittle to sectile
Chalcanthite (Blue Stone, Blue Vitriol, Kupfervitriol)	vitreous	blue	2.5	brittle to sectile
Vivianite (Blaueisenerz)	vitreous, pearly, dull	blue, green, white	2.5	sectile
Biotite (Magnesiaglimmer)	pearly on **0**	black, brown, dark green	2.5	brittle to sectile

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS Sp. Gr., Reactions. A — Associated Minerals.
O'rhm. *H.* colmn., acic. *S.* reniform, incrustations.	*Cl.* i ī observable. *Fr.* granular.	$ZnSO_4.7H_2O$	G. 2. Crystals rare. Soluble in water. Taste astringent, metallic, and nauseous. Yields water. BB *ch.* with soda, a coat of ZnO, and hepar reaction. *A.* Blende.
O'rhm. *H.* acic., capil. *S.* incrustations, coating.	*Cl.* i–ī distinct. *Fr.* granular, fibr., earthy.	$MgSO_4.7H_2O$	G. 1.7. Crystals rare. Soluble in water. Taste bitter and saline. Melts in candle flame. *A.* Marl, Pyrite.
Mcl. *H.* capil., acic., scaly. *S.* coating, massive, intsp.	*Cl.* i–ì perfect. *Fr.* earthy.	$Ni_3(AsO_4)_2.8H_2O$	G. 3. BB, see II. 5.
Mcl. *H.* capil., acic. *S.* spherical, botryoidal, hepatic, incrusted, coating.	*Cl.* ii perfect. *Fr.* fibr., stellate, earthy.	$(Ca,Mg)_3(AsO_4)_2.6H_2O$	G. 2.6. BB in closed tube yields water and becomes opaque. BB in O.F. fuses with intumescence to enamel and colors flame light blue (As); ignited mineral alkaline to test paper. Insoluble in water, but readily soluble in acids. *A.* Niccolite, Chloanthite, Pyrargyrite.
Isom. *H.* octahedral. *S.* massive.	*Cl.* 1 distinct. *Fr.* granular, compact.	Sb_2O_3	G. 5.2. Melts in candle flame. BB in closed tube fuses and partially sublimes. On coal gives white coating, which, in R.F., colors outer flame greenish blue. *A.* Valentinite, Kermesite native Antimony.
Trcl. *H.* tab., scaly. *S.* incrusted, rounded, coating.	*Fr.* compact, stalky	$CuSO_4.5H_2O$	G. 2.2. Crystals rare. Treat metallic, astringent. Soluble in water. Moistened and rubbed on knife-blade coats it with copper. BB yields water and SO_3. With soda on coal, metallic Cu. *A.* Melanterite, Pyrite, Chalcopyrite.
Mcl. *H.* acic., scaly. *S.* masv., intsp.	*Cl.* i–ì perfect. *Fr.* fibrous, earthy.	$Fe_3(PO_4)_2.8H_2O$	G. ± 2.5. (See II. 6.)
Mcl. *H.* foliaceous, scaly, tabular, short colmn. *S.* masv., intsp.	*Cl.* 0 highly eminent. *Fr.* shelly, scaly.	$(Mg,Fe)_2(K,H)_2(Al,Fe)_2(SiO_4)_3$	G. 2.9. Crystals seem hex. Yields a little water. Whitens and fuses on thin edges. With fluxes, reaction for iron. *A.* Constituent of Granite, Gneiss, Mica Slate.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Ripidolite (Klinochlor)	pearly on **0**	green; when containing chromium, blue	2.5	sectile
Halite (Common Salt, Steinsalz)	vitreous to resinous	white, gray, blue (seldom), red (seldom)	2.5	brittle to sectile
Sylvite† (Sylvin)	vitreous to resinous	white, gray	2.5	brittle to sectile
Kainite	vitreous	yellow, gray	2.5	sectile to brittle
Succinite† (Amber, Bernstein)	waxy	yellow, brown, red, white	2.5	brittle
Bieberite‡ (Kobaltvitriol)	silky to vitreous	flesh- to rose-red	2.5	sectile to brittle
Muscovite (Potash Mica, Kaliglimmer)	pearly on **0**, often metalloid	gray, white, light yellow, light brown	2.5	sectile
Valentinite† (Weissspiessglaserz)	adamantine pearly on **0**	white, gray, light yellow, light brown	2.5	sectile

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Mcl. (?) *H.* foliaceous, scaly, tab., pyr. *S.* masv., intsp., small reniform, lamellar.	*Cl.* **0** perfect. *Fr.* scaly, compact, short fibr.	$(Mg,Fe)_5Al_2H_9Si_3O_{20}$	G. ± 2.7. Crystals seem hexagonal. Often strongly dichroic. Transp. to transluc. crystals flexible and somewhat elastic. BB yields water. In platinum forceps fuses on edges to gray-black glass. In H_2SO_4 wholly decomp. *A.* Garnet, Diopside, Titanite, Adularia, Albite, Magnetite, Penninite, Serpentine, Chromite.
Isom. *H.* hexhdl. *S.* masv., intsp., lamellar.	*Cl.* cubic, perfect. *Fr.* gran., fibr.	NaCl	G. ± 2.1. Taste pure saline. Soluble in water. Solution precipitates $AgNO_3$. BB fuses often with decrepitation, and colors flame deep yellow. *A.* Clay, Gypsum, Anhydrite.
Isom. *H.* hexhdl., cubo-octdl. *S.* massive.	*Cl.* cubic, distinct. *Fr.* granular.	KCl	G. 2. Soluble in water. Pungent taste. BB melts on wire, coloring flame violet. *A.* Carnallite, Halite, Kainite.
Mcl. *H.* tabular. *S.* massive.	*Cl.* i–ī distinct I less so. *Fr.* fine gran.	$KCl,MgSO_4.3H_2O$	G. 2.1. Soluble in water. Taste pungent. BB melts in flame. *A.* Carnallite, Sylvite, Halite.
Amorphous. *S.* masv., lamel.	*Fr.* masv., conchoidal	$C_{40}H_{64}O_4$	G. ± 1. Electric by friction. Melts in candle flame and burns with illum. flame and pleasant odor. With H_2SO_4 brown solution. *A.* In loose masses, also in clays and marls sometimes.
Mcl. *S.* efflorescence.	*Fr.* crumbly	$CoSO_4.7H_2O$	G. 1.9. Taste astringent. Soluble in water. Yields water and SO_2 in closed tube. Blue, borax glass bead. *A.* Product of decomp. of cobaltiferous minerals.
Mcl. *H.* foliaceous, scaly, tab., pyr. *S.* masv., intsp.	*Cl.* **0** perfect. *Fr.* shelly, scaly, compact.	$(K,Na)H_2Al_3(SiO_4)_3$	G. 3. Crystals seem hex. In closed tube gives water. BB whitens and fuses on thin edges to gray or yellow glass. *A.* Principal constituent of Mica-schist, Gneiss, and Granite. Does not occur with Augite nor with Labradorite.
O'rhm. *H.* scaly, acic., splintery. *S.* massive.	*Cl.* I perfect. *Fr.* short stellate.	Sb_2O_3	G. 5.5. Melts in candle flame. In closed tube fuses and partially sublimes. BB *ch.* fuses easily and gives white coat, which imparts to R.F. green-blue color. *A.* Antimonite, Kermesite, Galenite, Blende.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Hydrozincite‡ (Zinkblüthe)	dull	white	2.5	sectile to brittle
Deweylite† (Gymnit)	resinous	yellow	2.5	brittle
Lepidolite† (Lithionglimmer, Lithionit)	**0** pearly, partly submetallic	violet, light red, dark green, gray	2.5	sectile
Phlogopite†	**0** pearly	brown, red, yellow	2.5	sectile to brittle

2.

Carnallite‡	vitreous	red, white	3	brittle
Glauberite‡	vitreous to resinous	white, gray, light yellow	3	brittle
Mellite‡ (Honigstein)	greasy	yellow, brown, white	3	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
(?) *S.* masv., reniform.	*Fr.* conchoidal, shelly, granular, compact, earthy	$Zn(OH)_2(ZnOH)_2CO_3$	G. ± 3.6. Soluble with effervescence. In closed tube yields water. BB yields CO_2, is yellow while hot. Coats coal near assay, which, with soda, yields Zn vapors. Moistened with Co sol. turns green. *A.* Calamine, Smithsonite.
Amorphous. *S.* massive.	*Fr.* compact	$Mg_4H_4Si_3O_{12}$	G. 2.2. Closed tube gives much water. BB fuses on edges and becomes opaque. Decomposed by HCl. *A.* Serpentine, Magnesite.
Mcl. *H.* foliaceous, scaly. *S.* massive.	*Cl.* 0 highly eminent. *Fr.* scaly, gran.	$Al_3Fe(Li,K,Na)_3(OH,F)_2Si_5O_{16}$	G. ± 2.9. Crystals seem hex. Melts in candle flame. Yields water. BB fuses with intumescence and colors flame lithium-red. *A.* Tourmaline bearing granites, and with tin ore.
Mcl. *H.* foliaceous, scaly, tab. *S.* interspersed.	*Cl.* 0 highly eminent	$(Al,Fe)_2(Mg,Fe)_5(K,Na)_2(OH,F)_2Si_6O_{21}$	G. 2.9. Crystals seem hex. Yields water which often tests for F. BB whitens and fuses on edges. Decomposed by H_2SO_4. *A.* Especially characteristic of serpentine and crystalline limestone and dolomite.

Sectile.

O'rhm. *H.* pyramidal. *S.* massive.	*Fr.* coarsely gran., compact	$MgCl_2.KCl.6H_2O$	G. 1.6. Crystals rare. Deliquescent. Taste pungent. Melts in candle flame. BB fuses easily. Soluble in water. Strongly phosphorescent. *A.* Sylvite, Kieserite, Halite.
Mcl. *H.* tab., colmn. *S.* massive.	*Cl.* 0 perfect. *Fr.* thin shelly.	$Na_2Ca(SO_4)_2$	G. ± 2 7. Taste bitter. Partially soluble in water. Melts in candle flame. BB decrepitates, turns white, and fuses, coloring flame yellow. With soda gives hepar reaction. *A.* Halite, clay.
Tetrag. *H.* pyramidal.	*Cl.* 1 distinct	$Al_2C_{12}O_{12}.18H_2O$	G. ± 1.5. Whitens in candle flame but does not take fire. Yields water. Decomposed by boiling water. Soluble in HNO_3. *A.* Lignite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Phosgenite‡ (Bleihornerz)	adamantine to resinous	gray-white, pale yellow, pale green	3	brittle
Mendipite‡ (Chlorspath, . Berzelite)	adamantine, pearly on cleavage planes	yellow, white to pale yellow	3	brittle
Caledonite‡ (Allied to Leadhillite)	resinous	verdigris-green mountain-green	3	brittle
Arsenolite‡ (Arsenolith)	adamantine	white	3	sectile
Wulfenite† (Gelbbleierz)	adamantine, vitreous, resinous	yellow, white, gray, red	3	brittle to sectile
Stolzite‡ (Scheelbleierz)	resinous	gray, brown	3	sectile
Calcite (Calc Spar, Iceland Spar)	vitreous, dull	in all colors, generally white	3	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Tetrag. *H.* colmn , pyr., cuboid.	*Cl.* I and ii perfect **0** distinct	$(PbCl)_2CO_3$	G. ± 6.2. Melts in candle flame. Effervesces with acids. BB melts easily to yellow globule, which, on cooling, becomes white and crystalline. *Ch.* in R.F. metallic lead and white coat of $PbCl_2$. Bead of mercsm. salt with Cu gives reaction for Cl. *A.* Cerussite, Galenite.
O'rhm. *H.* columnar. *S.* radial.	*Cl.* I perfect I ∧ I 102° 36′	$Pb_3O_2Cl_2$	G. ± 7.1. In closed tube decrepitates and becomes more yellow. BB fuses easily to lead button, and with mercsm. bead and Cu shows Cl. *A.* Earthy Manganese Oxide, clay.
Mcl. *H.* columnar. *S.* massive.	*Cl.* ii, also I and **0**. *Fr.* uneven.	$(Pb,Cu)_2SO_4CO_3$	G. ± 6.4. Partly soluble in HCl with effervescence. With soda, in R.F., button of lead. *A.* Lead ores, Linarite.
Isom. *H.* octdl., capil. *S.* botryoidal, stalac., earthy.	.....	As_2O_3	G. ± 3.7. Sublimes in tube, condensing on walls in minute octahedrons. BB *ch.* volatilizes, giving As odor amd white fumes. An isomeric mineral, Claudetite, crystallizes monoclinic. *A.* Ores of silver, lead, arsenical iron, etc.
Tetrag. *H.* tab., cuboid, pyramidal. *S.* massive.	*Cl.* 1 very smooth **0** distinct. *Fr.* granular.	$PbMoO_4$	G. ± 6.5. Closed tube decrepitates and fuses. BB, with borax, colorless glass, which, in R.F., becomes dirty green. *Ch.*, with soda, metallic lead. *A.* Calcite, Galenite.
Tetrag. *H.* pyr., cuboid, short tabular.	*Cl.* **0** imperf.	$PbWO_4$	G. ± 8. BB decrepitates and fuses to a crystalline, lustrous, and metallic pearl. With mercsm. salt in O.F. colorless glass, which, in R.F., becomes blue on cooling. Decomp. by HNO_3, leaving yellow residue of H_2WO_4. *A.* Lepidolite, smoky Quartz.
Hex. *H.* r'dl., colmn., acicular, tab., scalenohedral. *S.* masv., intsp., rounded, lamel.	*Cl.* R, 105°, highly perfect. *Fr.* gran., compact, stalky, fibr., earthy,	$CaCO_3$	G. ± 2.6. BB infusible. Strongly luminous. Soluble in acids with effervescence. *A.* In ore veins, limestone, geodes, etc., very widely distributed.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Vanadinite‡ (Vanadinspath, Vanadinbleispath)	resinous	yellow, brown	3	brittle
Anhydrite (Karstenit)	vitreous, ii pearly, resinous	white, pale red, pale blue, gray	3	brittle
Celestite (Cölestin)	vitreous, 0 somewhat pearly	white, blue	3	brittle
Barite (Heavy Spar, Barytes, Schwerspath)	vitreous, 0 somewhat pearly, resinous, silky	all colors, principally red and yellow	3	brittle
Anglesite (Vitriolbleierz)	adamantine resinous	white	3	brittle
Beauxite	dull, earthy	whitish, grayish to ochre-yellow, brown, and red	3 (?)	sectile
Polyhalite‡	vitreous, resinous, silky	red, gray	3	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Hex. *H.* acic, short columnar. *S.* small reniform.	*Fr.* fine stalky, fibrous	$Pb_5Cl(VO_4)_3$	G. ± 6.9. In closed tube decrepitates and yields faint white sublimate. BB *ch.* fuses to black mass, which, in R.F., gives metallic bead. After oxidizing all the lead the black residue gives, with mercsm. salt in R.F., green bead, which becomes yellow in O.F. *A.* Calcite, Galenite.
O'rhm. *H.* tab., cuboid, splintery, short columnar. *S.* masv., lamel.	*Cl.* i ĭ perfect, ĭ 0 } dist. *Fr.* granular, stalky, compact, splintery.	$CaSO_4$	G. 2.9. Crystals rare. Soluble in HCl. BB fuses, coloring flame reddish yellow, and yielding bead which reacts alkaline. *A.* Clay, Calcite, Gypsum, Halite.
O'rhm. *H.* tab., colmn., acic. *S.* masv., lamel., nodular.	*Cl.* 0 perfect, I observbl., I ∧ I, 104° *Fr.* stalky, fibr., fine gran., compact.	$SrSO_4$	G. 4. BB frequently decrepitates and fuses to white pearl, coloring flame red, and giving off SO_2. *Ch.* fuses easily to a button. Residue alkaline. With soda, hepar reaction on silver. *A.* Limestone, marl, Calcite, Gypsum, Sulphur, also in Galena veins.
O'rhm. *H.* tab., colmn., acic., pyr. *S.* rounded, lamellar, masv.	*Cl.* 0 perfect, I observbl., I ∧ I, 102° *Fr.* shelly, fibr., gran., compact, earthy	$BaSO_4$	G. 4.3–4.7. BB decrepitates and fuses, coloring flame yellowish green and giving off SO_2. With soda, hepar reaction on silver. *A.* Fluorite, Galenite, Argentite, Pyrargyrite, Proustite, Niccolite, Chloanthite, Chalcopyrite, Pyrolusite, Psilomelane, Hematite, Limonite. Frequent in gangues of silver and lead ores.
O'rhm. *H.* tab., colmn., acic., pyr. *S.* massive.	*Cl.* 0 perfect, I observbl., I ∧ I, 104° *Fr.* compact.	$PbSO_4$	G. ± 6.2. Crystals rare. Decrepitates. Fuses in candle flame. BB *ch.*, in O.F., clear bead, which becomes milk-white on cooling. R.F. reduced with effervescence to metallic lead. With soda, hepar reaction. *A.* Cerussite, Galenite.
(?) *S.* in round dissem. grains, masv., oolitic, earthy.	*Fr.* earthy	$Al_2O(OH)_4$	G. 2.5. In matrass yields water. With cobalt solution, blue color. *A.* Limestone.
(?) (usually compact, fibrous) *H.* splintery. *S.* massive.	*Fr.* stalky, fibr.	$Ca_2Mg,K_2(SO_4)_4.2H_2O$	G. 2.7. Crystals rare. Melts in candle flame. Yields water. BB fuses and colors flame yellow. *Ch.* fuses to reddish bead, which in R.F. becomes white. Partially soluble in water, leaving $CaSO_4$, which dissolves in large excess of water. *A.* Halite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Kieserite† (Kieserit)	glinting	white, gray, light yellow	3	brittle
Cryolite (Kryolith)	vitreous, pearly	white, gray	3	brittle
Allophane† (Riemannit)	vitreous	white, blue, yellow, green, brown	3	brittle
Wavellite† (Hydrargyrite, Striegisan)	vitreous, silky	in all colors, principally yellow, green, and white	3	brittle
Peganite‡	vitreous, resinous	green, gray, white, bluish	3.5	brittle
Adamite	vitreous to adamantine	honey-yellow; externally, often violet. Streak, white	3.5	sectile
Pyromorphite (Grünbleierz, Braunbleierz, Buntbleierz)	resinous to vitreous or adamantine	green, brown, yellow, white	3.5	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Mcl. *H.* pyramidal. *S.* massive.	*Cl.* 1 distinct. *Fr.* gran., compact.	$MgSO_4.H_2O$	G. 2.5. Weathers easily. Absorbs water. Crystals rare. Soluble in water. Fuses easily. *A.* Carnallite, Sylvite, Halite.
Mcl. *H.* short colmn., cuboid. *S.* massive.	*Cl.* in three nearly perpendicular planes. *Fr.* coarse gran., large shelly.	$AlF_3.3NaF$	G. ± 3. Crystals rare and apparently isom. Melts in candle flame. Heated in open tube so that flame enters tube, gives off HOF and etches glass. Colors flame yellow, and gives blue with Co solution. *A.* Siderite, Galenite, Chalcopyrite, Zincblende.
Amorphous. *S.* usually in thin incrustations, mammillary, stalactitic, massive.	*Fr.* conchoidal, compact	$Al_2SiO_5.5H_2O$	G. 1.8. Yields much water in closed tube. Crumbles. Gelatinizes with HCl. BB infusible. *A.* Limonite, alum slates.
O'rhm. *H.* acicular. *S.* reniform, hemispherical.	*Cl.* distinct. *Fr.* radial.	$((Al.OH)_3(PO_4)_2)_2.9H_2O$	G. 2.3. Crystals small and rare. Yields much water, last portions of which taste acid. BB, in forceps, swells and splits to fine acicular particles, which are infusible, but color flame green. With Co solution, blue. *A.* Hematite, Limonite, Pyrolusite, quartz slates, sandstones.
O'rhm. *H.* short acic. *S.* incrusted, warty.	*Fr.* short fibr. to compact	$(OH_3Al_2PO_4)_2.3H_2O$	G. 2.5. Yields water and becomes violet. Cracks open. BB infusible. *A.* Wavellite.
O'rhm. *H.* short colmn. *S.* interspersed, coating.	*Cl.* i–ī very distinct	$(ZnOH)ZnAsO_4$	G. 4.34. Easily soluble in dilute HNO_3. In matrass decrepitates feebly and yields a little water, becoming white and porcelanous. With soda, a ring of As. BB *ch.* coating of ZnO and feeble odor of As. Borax, in O.F., pearl-yellow, but colorless on cooling. *A.* Limonite, native Silver.
Hex. *H.* long and short columnar, acicular. *S.* reniform, botrydl., masv., incrusted.	*Fr.* compact, short radial	$Pb_5Cl(PO_4)_3$	G. 6.5–7.1. In closed tube, white sublimate ($PbCl_2$). Fuses easily, coloring flame bluish green. BB *ch.* fuses, and, on cooling, assumes polyhedral forms. Soluble in HNO_3. Cl reaction with mercsm. salt and CuO. *A.* Cerussite, Galenite, Barite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Chrysocolla (One variety) (Kieselkupfererz) (See II. 2, 3, 5)	dull, usually glinting; when lustrous, greasy	verdigris-green to sky-blue	3.5	brittle
Descloizite (Rhombischer Vanadit)	vitreous	black to olive-brown	3.5	sectile
Mimetite† (Mimetesit, Kampylit)	resinous to adamantine	yellow, brown, white, gray	3.5	brittle
Cerussite (Weissbleierz)	adamantine, resinous, pearly, silky	white, gray, black, brown	3.5	brittle
Laumontite‡ (Caporcianite)	vitreous, silky, I pearly	white, pale yellow, pale red	3.5	brittle
Picrolite (Serpentine, Chrysotile, Ophite)	feebly lustrous to earthy; *chrysotile* silky	dark green, less frequently yellow, red, brown	4	brittle to sectile
Stilbite† (Desmin)	vitreous, silky, i–ĭ pearly	white, less frequently yellow, brown, and red	4	brittle
Heulandite‡ (Stilbite in part)	vitreous i–ì pearly	white, red, less frequently yellow, brown	4	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Amorphous. *S.* fine reniform, botrydl., masv., intsp.	*Fr.* massive, conchoidal in part	$CuSiO_3.2H_2O$	G. ± 2.2. BB infusible. In closed tube blackens and yields water. With fluxes, reaction for copper. Gelatinizes with acids. *A.* Malachite, Cuprite, Chalcopyrite, Limonite.
O'rhm. *S.* in clusters.	.....	$(Pb,Zn)VO_4(Pb,OH)$	G. 5.8. In matrass gives water. BB fuses and is partially reduced to button of metallic lead in a thick scoria. With borax in R.F. green glass, and with nitre in O.F. violet color, due to Mn. Microcosmic salt, chrome-green glass, orange-yellow in O.F. Dissolves in cold dilute HNO_3. *A.* Green Pyromorphite.
Hex. *H.* short and long columnar, acic., thick tab., pyramidal.	*Cl.* 1 distinct	$Pb_5Cl(AsO_4)_3$	G. ± 7.1. Closed tube, white sublimate ($PbCl_2$). BB fuses to button. In R.F., As odor and reduced to metallic lead. Reacts for Cl with bead of mercsm. salt saturated with CuO by coloring flame azure blue. *A.* Limonite, Psilomelane.
O'rhm. *H.* colmn., acic., tabular, pyr. *S.* massive, incrustations.	*Cl.* I perfect 1–ĭ distinct i–ĭ distinct. *Fr.* fine gran., earthy, compact.	$PbCO_3$	G. 6.4. Sometimes crystals seem hexag. Often twins, and closed tube decrepitates and turns yellow. BB fuses very easily, and in R.F. yields metallic lead. Soluble with effervescence in HNO_3. *A.* Pyromorphite, Galenite, Malachite, Limonite.
Mcl. *H.* colmn., acic. *S.* massive.	*Cl.* I distinct. *Fr.* stalky.	$Al_2(OH)_4Ca(Si_2O_5)_2.2H_2O$	G. 2.3. Weathers easily. Gelatinizes with HCl. BB fuses easily and swells up to white enamel. *A.* Stilbite, Calcite.
O'rhm. *S.* massive, incrusted.	*Fr.* compact, conchoidal, splintery	$(Mg,Fe)_3H_4Si_2O_9$	G. ± 2.6. Yields water; fuses on edges with difficulty. Decomposed by HCl and H_2SO_4. Chrysotil leaves SiO_2 in fine fibres.
Mcl. *H.* broad colmn, splintery. *S.* massive.	*Cl.* in one direction	$(Ca,Na_2K_2)Al_2Si_6O_{16}.6H_2O$	G. 2.1. Crystals simulate o'rhm. Attacked by acids without gelatinizing. BB exfoliates and curves into vermicular forms, and fuses to a white enamel. *A.* Heulandite, Chabasite, Laumontite, Calcite.
Mcl. *H.* tab., scaly, short colmn. *S.* masv., intsp.	*Cl.* eminent in one direction. *Fr.* thin shelly.	$Al_2(Ca,Sr)H_4(SiO_3)_6.3H_2O$	G. ± 2.2. Decomposed by HCl without gelatinizing. BB curls up, exfoliates, and fuses to white enamel. *A.* Stilbite, Calcite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Scorodite† (Arseniksinter, Eisensinter)	vitreous	green, brown	4	brittle
Alunite† (Alaunspath)	vitreous, 0 pearly	white, gray, light yellow, light red, brown	4	brittle
Strontianite	vitreous, resinous	white, gray, pale yellow, pale green	4	brittle
Witherite†	vitreous to resinous	white, gray, pale yellow	4	brittle
Aragonite	vitreous, silky, resinous	white, gray, pale yellow, less frequently green, blue, red, violet	4	brittle
Bromlite (Alstonite)	vitreous, resinous	white	4	brittle
Barytocalcite	vitreous	white, yellowish	4	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *H.* pyramidal, short colmn., short acicular. *S.* masv., finely reniform.	*Cl.* i–ĭ distinct. *Fr.* stalky, fine-gran., compact.	$FeAsO_4.2H_2O$	G. ± 3.2. In closed tube yields neutral water and turns yellow. BB fuses easily, coloring flame blue, leaving magnetic scoria. *A.* Pharmacosiderite, Limonite, Arsenopyrite, Pyrite.
Hex. *H.* r'dl., tab., like octahedral, like hexahedrl. *S.* massive, nodular.	*Cl.* 0 perfect. *Fr.* granular, masv., earthy.	$(AlO)_3K(SiO_4)_2.3H_2O$	G. ± 2.6. Crystals very small. Decrepitates and is infusible. Yields water, sometimes $(NH_4)_2SO_4$. With Co solution yields fine blue color. With soda, hepar reaction. *A.* On Trachyte. Nodular. In sand.
O'rhm. *H.* acic., dart-like, acute pyr. *S.* massive.	*Cl.* I distinct 1–ĭ " *Fr.* fibrous, thin stalky.	$(Sr,Ca)CO_3$	G. ± 3.7. BB swells up. Throws out minute sparks, fuses only on thin edges, and colors flame Sr red. Effervesces with acids. H_2SO_4 produces precipitate in dilute solution. *A.* Silver, Lead, and Copper veins; also in deposits by itself.
O'rhm. *H.* pyr., tab., columnar. *S.* massive, reniform.	*Cl.* I distinct i–ĭ, i–ĭ } less so. *Fr.* radial.	$BaCO_3$	G. ± 4.2. Crystals simulate hex. BB fuses to bead and colors flame yellowish green. Assay tests alkaline after fusion. Dissolves in HCl with effervescence. The dilute solution precipitates white with H_2SO_4. *A.* Galenite, Alstonite, Barytocalcite.
O'rhm. *H.* acic, long and short columnar, thick tab., dart-like, chisel-like. *S.* masv., lamel., renfrm, spherdl, hackly, incrust.	*Cl.* i–ĭ distinct I } 1–ĭ } traces. *Fr.* stalky, fibr., shelly, compact.	$CaCO_3$	G. 2.9. Often twinned and multiple twinned. BB falls to pieces, loses CO_2, and glows brightly. Dissolves with effervescence in acids. Moistened with HCl gives Ca color to flame. *A.* In veins of limestone, Dolomite, and basalt. In Gypsum, Limonite, and Siderite deposits.
O'rhm. *H.* acute pyr. *S.* massive.	*Fr.* fibrous, granular	$(Ca,Ba)CO_3$	G. 3.7. Crystals simulate hexagonal. Soluble in hydrochloric acid with effervescence. BB fuses on thin edges and colors flame yellowish green. Alkaline after ignition. *A.* Witherite, Barytocalcite.
Mcl. *H.* acicular. *S.* massive.	*Cl.* I perfect. *Fr.* granular, stalky.	$(Ca,Ba)CO_3$	G. 3.6. Dissolves in dilute HCl. BB infusible. Colors flame yellowish green. Strong ignition pale green color and afterwards alkaline reaction. *A.* Alstonite, Witherite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Triphylite† (Triphylin)	resinous	greenish, gray, blue in spots	4	brittle
Picrolite‡ (Variety Serpentine) (See III. 2, *ante*)	feebly waxy	yellow, green, white	4	brittle to sectile
Zinc Blende (Blende, Black Jack, Sphalerite)	adamantine	yellow, red, green, and white very seldom	4	very brittle
Bismutite (Bismutosphärit, Wismuthocher in part)	generally dull or glinting, resinous	gray, light yellow, light green	4	brittle
Fluorite	vitreous	in all colors; black, red, and brown are most *uncommon*	4	brittle
Ankerite (Braunspath in part)	vitreous, pearly	gray, white, yellowish, brownish	4	brittle
Dolomite (Bitterspath, Braunspath in part)	vitreous R partly pearly	white, gray, yellow, red, brown, green	4	brittle

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
O'rhm. *S.* massive.	*Cl.* i–ĭ distinct **0** less so. *Fr.* large gran.	$Li(Fe,Mn)PO_4$	G. ± 3.6. Weathers. BB turns dark and gives off some water. Fuses, coloring flame Li red, with pale bluish green at exterior cone of flame. With borax, an iron bead. With soda, reaction for Mn. Soluble in HCl. *A.* Beryl. In granite.
Amorphous. *S.* incrusted, massive.	*Fr.* compact; in large pieces, conchoidal; in small, splintery	$(Mg,Fe)_3H_4Si_2O_9$	G. ± 2.5. Greasy to touch. Bitter odor when breathed on. Fibres not flexible. Yields water. Fuses on edges with difficulty. *A.* Serpentine.
Isom. *H.* octahedral, tetrdl., dodecdl. *S.* masv., intsp., rounded.	*Cl.* I perfect. Bethlehem variety very slight. *Fr.* granular, compact.	ZnS or $(Zn,Fe,Mn,Cd)S$	G. ± 4. Open tube SO_2, and generally changes color. BB very difficult to fuse. *Ch.*, with soda, green Zn flame. In R.F. on coal a zinc coat. Bethlehem variety crypto-crystalline. *A.* (1) Arsenopyrite, Chalcopyrite, Pyrite, Galenite, Siderite, Baryte. (2) Pyroxene, Aplome-Garnet, Magnetite, Magnetopyrite. Frequent in gangues of silver and lead ores.
Crystalline. *S.* masv., intsp., small spheroid.	*Fr.* earthy, compact, crumpled, shelly	$BiO.Bi(OH)_2CO_3$	G. 6.9. Soluble in HCl with effervescence and deep yellow solution. Melts in candle flame. In matrass decrepitates and gives water. BB R.F. button of Bi and gives coal yellow coat. *A.* Native Bismuth and Bismuthinite.
Isom. *H.* hexahedral, octahedral. *S.* masv., intsp.	*Cl.* 1 perfect. *Fr.* stalky, compact, gran., earthy.	CaF_2	G. ± 3.1. In closed tube decrepitates, loses color, and phosphoresces. BB fuses, coloring flame red. Residue reacts alkaline. With H_2SO_4, fumes etch glass. *A.* In gangues of metallic ores. In beds and veins. With gneiss, mica slate, clay slate, and in limestones. With a great many minerals.
Hex. *H.* obtuse r'dl. *S.* massive.	*Cl.* R, 106°, perfect; faces often curved. *Fr.* granular.	$(Ca,Mg,Fe,Mn)CO_3$	G. 3. Soluble with effervescence in HCl. BB infusible. Darkens and becomes magnetic. *A.* Siderite, Galenite, Blende.
Hex. *H.* acute or obtuse r'dl. *S.* massive.	*Cl.* R, 106°, perfect; faces often curved. *Fr.* granular, compact.	$(Mg,Ca)CO_3$	G. 2.8. Soluble with effervescence in warm HCl, slowly in cold HCl. BB does not fuse to clear mass with soda on platinum foil. Glows and gives off CO_2. *A.* In extensive beds. Serpentine and other magnesian rocks. With a great many minerals.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	TENACITY.
Pistomesite (Breunerite)	vitreous, R pearly	yellowish white yellowish gray	4	brittle
Siderite (Spathic Iron, Eisen Spath, Spatheisen stein)	vitreous, R pearly	pea-yellow Isabella-yellow yellow-gray yellow-brown	4	brittle

3.

NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Magnesite† (Talkspath, Bitterspath)	vitreous, dull	white, pale yellow, gray, black	4.5	Hex. *H.* obtuse r'dl. *S.* massive, reniform.
Rhodochrosite† (Rose Spar, Manganspath, Manganocalcit, Dialogit)	vitreous, partly pearly and resinous	rose-red	4.5	Hex. *H.* obtuse and acute r'dl., acute scalenohedral. *S.* spherical, reniform, massive.
Smithsonite (Zinkspath, Galmei in part)	vitreous to resinous	white, pale yellow, pale green, gray, brown	4.5	Hex. *H.* obtuse and acute r'dl., acute scalenohedral. *S.* botrydl., reniform, warty, masv.
Margarite† (Perl-Glimmer, Kalkglimmer)	**0** pearly	white, gray, pale green	4.5	Mcl. *H.* thin tabular, scaly. *S.* massive.

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CRYSTAL SYSTEM, HABIT, AND STRUCTURE.	CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS, Sp. Gr., Reactions. *A* = Associated Minerals.
Hex. *H.* obtuse r'dl. *S.* massive.	*Cl.* R perfect. *Fr.* coarsely granular, large granular	$(Mg,Fe)CO_3$	G. 4. Soluble with effervescence in warm HCl. BB infusible. *A.* Pyrite, Specularite.
Hex. *H.* obtuse r'dl., lentic., scalndl., acute r'dl. *S.* masv., reniform, warty, nodular, lamel.	*Cl.* R, 107°, perfect; faces often curved. *Fr.* gran., compact, shelly, rarely fibrous.	$FeCO_3$	G. ± 3.8. Dissolves with effervescence in warm HCl. BB decrepitates, evolves CO_2, blackens, and becomes magnetic. With fluxes reacts for Fe, and with soda and nitre on platinum foil generally for Mn. *A.* In silver and tin gangues, also with gneiss, mica slate, and clay slate, and as clay ironstone in coal measures.

Semi-hard.

CLEAVAGE AND FRACTURE	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Cl. R, 107° 30′, perfect. *Fr.* granular, compact, earthy.	$MgCO_3$	G. 3. Effervesces with acids. BB infusible, whitens, loses CO_2, and glows brightly. Residue alkaline. With Co solution on platinum foil red color. *A.* Chlorite slate, Talc slate, Serpentine.
Cl. R, 107°, perfect, curved faces in part	$(Mn,Ca,Fe,Mg)CO_3$	G. ± 3.5. BB changes to gray, brown, and black. Decrepitates, but is infusible. With mercsm. salt and borax, in O.F., amethyst bead. R.F., by continued blowing, colorless. Co solution on platinum foil bluish green. Dissolves with effervescence in warm HCl. *A.* (1) Galenite, Blende, argentif. Tetrahedrite, native Gold. (2) Limonite, Hematite.
Cl. R, 108°, perfect, curved faces in part	$ZnCO_3$	G. ± 4.2. Crystals mostly small. Soluble in warm HCl with effervescence. In closed tube yields CO_2, and is yellowish hot, and white cold. BB infusible. Co solution gives green color. *A.* Calamine, Galenite, Blende.
Cl. 0 perfect. *Fr.* scaly, gran.	$H_2CaAl_4Si_2O_{12}$	G. 3. Yields water in closed tube. BB whitens and fuses on edges. *A.* Chlorite, Corundum, Magnetite, Rutile.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT. AND STRUCTURE.
Scheelite† (Scheelspath)	resinous to adamantine	brown, yellow, gray, white	4.5	Tetrag. *H.* pyr., seldom tab., lenticular. *S.* masv., intersp.
Triplite†	resinous	brown, black	4.5	Mcl. *S.* masv., intersp.
Wollastonite†	vitreous, O pearly, silky	white, gray, seldom pale red, pale yellow	4.5	Mcl. *H.* tab., splintery. *S.* massive.
Chabazite† (Phakolith)	vitreous	white	4.5	Hex. *H.* r'dl. cuboid, obtuse pyr., lentic.
Apophyllite† (Fischaugenstein, Ichthyopthalmit, Tesselite, Oxhaverite, Xylochlor, Leucocyclite)	vitreous O pearly	white, pale yellow, pale red	5	Tetrag. *H.* tab., colmn., acute pyr., cuboid. *S.* massive.
Eulytite‡ (Kieselwismuth, Agricolit)	adamantine	brown, yellow, gray, white	5	Isom. *H.* trigon., dodcl., often rounded. *S.* spheroidal. *Agricolit* Mcl.
Calamine (Kieselzinkerz, Galmei in part, Hemimorphite)	vitreous, pearly, silky	white, pale yellow, pale blue	5	O'rhm. *H.* tab., splintery, acic., capillary. *S.* reniform, incrusted.
Enstatite† (Bronzite)	i–ĭ metallic, pearly, silky	brown, green	5	O'rhm. *H.* colmn., acic.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals
Cl. 1 2–i **0** } perfect	$CaWO_4$	G. ± 6. Fuses to semi-transparent glass, which is opaque on cooling. BB, with mercsm. salt, a bead, colorless in outer flame; in inner, green while hot and blue when cold. Decomposed by HCl, leaving yellow residue, soluble in ammonia. *A.* (1) Wolframite, Cassiterite, Fluorite, Lepidolite. (2) Galenite, Blende, Siderite. (3) Magnetite, Blende, Pyrite. (4) On and in limestone.
Cl. i–ī distinct **0** less so	$(Fe,Mn)PO_4(Fe,Mn)F$	G. ± 3.6. BB fuses easily to black magnetic globule. With borax in O.F., amethyst bead of Mn; with soda, Fe reaction; with H_2SO_4, evolves F and etches glass. *A.* Apatite, Beryl.
Cl. i–ī **0** 1–ī ½–ī } rather perfect. *Fr.* shelly, stalky, fibrous.	$CaSiO_3$	G. ± 2.8. Rubbed or warmed becomes phosphorescent in the dark. In matrass no change. BB fuses easily on edges. Gelatinizes with HCl. *A.* Calcite, Garnet, Vesuvianite, Graphite, Bornite.
Cl. R distinct	$Al_2(Ca)Si_6O_{16}.8H_2O$ $Al_2(Ca)_2Si_4Al_2O_{16}.8H_2O$	G. ± 2.1. Often twinned. BB intumesces and fuses to blebby glass nearly opaque. Decomposed by HCl with separation of gelatinous silica. *A.* Phillipsite, Stilbite, Heulandite, Analcite, Calcite.
Cl. **0** distinct i–i distinct. *Fr.* large shelly.	$(Ca_4KH_7(SiO_3)_8)_2.9H_2O$	G. 2.3. In closed tube exfoliates, whitens, and yields water. BB exfoliates and colors the flame violet. With acids, slimy silica. *A.* Analcite, Natrolite, Calcite.
Fr. radial.	$Bi_4(SiO_4)_3$	G. 6. In matrass decrepitates and yields a little water. BB fuses and froths on coal, staining it yellow-brown. Fuses with soda to button, at first greenish yellow, then reddish yellow, and yields finally metallic Bi. *A.* Bismutite, Hypochlorite.
Cl. I perfect 1–ī distinct	$(Zn.OH)_2SiO_3$	G. 3.16–3.9. Crystals generally small. In closed tube decrepitates, whitens, and gives water. BB moistened with Co solution gives green color when heated. *Ch.* with soda gives yellow coat, which cools to white. By HCl decomposed and gives gelatinous silica. *A.* Smithsonite.
Cl. i–ī perfect I imperfect i–ī in traces. *Fr.* large and coarse gran., fibr.	$(MgFe)SiO_3$	G. ± 3.2. BB infusible, being only slightly rounded on edges. Insoluble in HCl. *A.* Olivine, *never quartz*, Serpentine, basalt, meteorites.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Apatite	vitreous resinous	in all colors	5	Hex. *H.* tab., colmn., acicular. *S.* massive, reniform, botryoidal.
Carpholite‡	silky	straw-yellow	5	Mcl. *H.* acic., capillary. *S.* massive.
Pyrgom or **Fassaite** (Green Augite in part. Variety Pyroxene)	vitreous, partly resinous	green, generally dark green	5	Mcl. *H.* short colmn., acute pyr. *S.* massive.
Haüynite	vitreous to resinous	blue, seldom white	5	Isom. *H.* dodcl., octdrl. *S.* intersp., masv.
Datolite (Humboldtite, Botryolit)	vitreous to resinous	white	5	Mcl. *H.* short colmn., thick tabular. *S.* massive, small reniform.
Harmotome (Kreuzstein, Morvenit)	vitreous	white, pale yellow, pale brown	5	Mcl. *H.* broad colmn., thick tabular.
Phillipsite (Kalkharmotom, Christianit)	vitreous	white	5	Mcl. *H.* short acicular.
Natrolite (Mesotype, Skolecit, Nadelzeolith)	vitreous, I pearly and silky	white, pale yellow, pale red, ochre-yellow, brick red	5	Mcl. and O'rhm. *H.* acic., colmn., capillary. *S.* reniform, incrustation, masv.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. *A* = Associated Minerals.
Cl. **0** distinct I distinct. *Fr.* fibrous, compact, earthy, gran.	$FCa_5(PO_4)_3$ $ClCa_5(PO_4)_3$	G. ± 3.1. BB fuses with difficulty on edges, coloring flame reddish yellow. Moistened with H_2SO_4 colors flame bluish green. Some varieties give blue flame when treated with mercsm. bead saturated with CuO—(Cl), and some give F when fused with mercsm. salt in open tube. *A.* (1) Cassiterite, Wolframite, Arsenopyrite, Fluorite. (2) Adularia, Quartz, Pistacite, Axinite, Titanite, Rutile, Specularite, Magnetite. (3) Chlorite slate, Talc slate. (4) Basalt, phonolite, diabase.
Fr. radial	$MnAl_2(OH)_4(SiO_3)_2$	G. 2.9. In closed tube gives some water, which reacts acid and attacks the glass (F). BB swells up and fuses to brown glass. With fluxes gives reactions for Mn and Fe. Not decomposed by HCl. *A.* Fluorite.
Cl. I distinct I ∧ I, 87°. *Fr.* gran., compact.	$MgCa(SiO_3)_2$	G. ± 3.3. Includes green pyroxene found in metamorphic rocks. Generally unacted on by acids. *A.* Calcite, Spinel. *Not Quartz.*
Cl. dodcl. distinct. *Fr.* gran., compact.	$(Ca,Na_2)Na_3(AlSO_4Na)$ $Al_3(SiO_4)_4$	G. ± 2.4. Crystals extremely rare. In closed tube retains its color. BB in forceps fuses to a white glass. With soda, *ch.*, gives hepar reaction with silver. Decomposed by HCl, with separation of gelatinous silica. *A.* In trachyte, basalt, phonolite, lava. *Not with Quartz.*
Cl. **0** distinct. *Fr.* granular, fine fibrous.	$Ca(B.OH)SiO_4$	G. 2.9. In closed tube yields much water. BB fuses with intumescence to clear glass, coloring flame bright green. Gelatinizes with HCl. *A.* Prehnite, Calcite, Magnetite.
Cl. i–ì perfect	$Al_2(Ba,Ca_2,Na_2,K_2)Si_6O_{16}\cdot 6H_2O$ $Al_2(Ba,Ca_2,Na_2,K_2)_2Si_4Al_2O_{16}\cdot 6H_2O$	G. 2.4. Crystals seem o'rhm. or tetrag. Often in double twins. BB whitens and then crumbles, and fuses, without intumescence, to white translucent glass. Sometimes phosphorescent when heated. Gelatinizes with HCl. *A.* Calcite, Galenite.
Cl. i–ì perfect	$Al_2(Ca,Na_2,K_2)Si_6O_{16}\cdot 6H_2O$ $Al_2(Ca,Na_2,K_2)Si_4Al_2O_{16}\cdot 6H_2O$	G. 2.2. BB, same as preceding. *A.* Analcite, Chabazite.
Cl. I perfect I ∧ I, 91°. *Fr.* radial, compact, earthy.	$(AlO)Na_2 2H_2O.Al(SiO_3)_3$ or $Al_2(SiO_4)_3Na_2H_4$	G. ± 2.2. Dimorphic. Crystals often seem tetrag. Melts in candle flame. BB fuses quietly to a colorless glass. Gelatinizes with acids. *A.* Chabazite, Apophyllite, Calcite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Opal	vitreous, waxy	in all colors, most frequently white, yellow, red, brown	5	Amorphous. *S.* masv., intersp., lamel., brecciated, incrustations, rounded.
Perlite (Perlstein). A rock	vitreous, partly pearly	gray	5	Amorphous. *S.* massive.
Cerite (Ochroit, Cererit, Lanthanocerit)	resinous	reddish gray, brownish gray	5	O'rhm. *H.* short colmn. *S.* massive.
Pitchstone† (Pechstein, Resinit). A rock	resinous	green, red, brown, black	5	Amorphous. *S.* massive.
Hedenbergite (Iron-lime Pyroxene)	vitreous	leek-green olive-green dark green	5	Mcl. *S.* massive.
Wagnerite‡	resinous	yellow, white	5	Mcl. *H.* short colmn. *S.* massive.

4.

Amblygonite‡ (Montebrasit)	vitreous, resinous, pearly	white, gray, pale green, and yellowish green	5.5	Trcl. *S.* massive.
Lazulite† (Blauspath)	vitreous	blue	5.5	Mcl. *H.* pyr., tabular, columnar. *S.* masv., intersp.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Fr. conchoidal, compact	$(H_2O)_xSiO_2$	G. ± 2. BB yields water. Infusible, but becomes opaque. Some yellow varieties turn red. *A.* In fractures of many rocks.
Fr. in large mass round granular; in small, conchoidal	$K_2Al_2Si_8O_{20}.H_2O$ Albite and Oligoclase or Orthoclase felspars, occurring as an *acidic igneous* rock. Silica 70 p.c.	G. ± 2.4. *A.* Imbedded. Spherulite, obsidian, Orthoclase, Biotite.
Fr. fine granular, splintery	$(Ce,La,Di,Al)_2(OH)_3$ $CeO(Ca,Fe)(SiO_3)_3$	G. 4.9. Crystals extremely rare. Gelatinizes in HCl. BB infusible, but becomes dirty yellow. With borax in O.F. very dark yellow glass when hot, becoming light yellow on cooling and colorless in R.F. In mercsm. salt, silica. *A.* Actinolite, Orthite, Chalcopyrite.
Fr. conchoidal, compact	$Na_2Al_2Si_{10}O_{24}.3H_2O$ A natural hydrous glass	G. ± 2.2.
Cl. I distinct I ∧ I, 87°. *Fr.* broad stalky, fibrous.	$FeCa(SiO_3)_2$	G. 3.5. Weathering. BB fuses easily to bead. *A.* Magnetite, Chalcopyrite, Blende, Pyrite.
.....	$Mg(MgF)PO_4$	G. 3. BB fuses in forceps to greenish-gray glass. Moistened with H_2SO_4 colors flame bluish green. With borax, iron reaction; with soda, effervesces, but not entirely dissolved. With H_2SO_4 gives off HF. Soluble in HCl. *A.* Lazulite, Magnesite, Siderite, Barite.

Hard.

Cl. nearly perfect in three directions. *Fr.* large gran., compact.	$(Al\,F)LiPO_4$ $(Al.OH)LiPO_4$	G. ± 3.1. In closed tube yields water, which finally, at high heat, becomes acid and corrodes glass. Fuses easily with intumescence, and cools into opaque white. Colors flame yellow-red; with Co solution deep blue. In fine powder dissolves in H_2SO_4. *A.* Lepidolite, Tourmaline, Topaz. In granite.
Fr. granular, compact	$(Al.OH)_2(Mg,Fe,Ca)(PO_4)_2$	G. 3. In closed tube whitens and yields water. Co solution the blue color is restored. BB in forceps whitens, swells, and falls to pieces without fusing, coloring flame bluish green. Unacted on by acids, retaining blue color. *A.* On Quartz veins.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Willemite†	vitreous to resinous	white, gray, pale yellow, pale green, brown, red	5.5	Hex. *H.* r'dl., tetartodrl, acic., columnar. *S.* massive.
Thomsonite† (Comptonit)	vitreous, partly pearly	white	5.5	O'rhm. *H.* cuboid, short acicular. *S.* masv., rounded.
Analcite† (Analcim)	vitreous	white, pale red	5.5	Isom. *H.* ikositdrl., hexhdrl. *S.* massive.
Nosite† (Nosean)	vitreous to resinous	gray, brown, white, black	5.5	Isom. *H.* dodecdrl. *S.* intersp., masv.
Sodalite‡	greasy to vitreous	blue, gray, green, white	5.5	Isom. *H.* dodecdrl. *S.* masv., intersp.
Perofskite‡ (Perowskite)	resinous adamantine sub-metallic	black, brown, red, yellow	5.5	Isom. *H.* cuboid. *S.* intersp., small reniform.
Brookite† (Arkansite)	adamantine sub-metallic	red, brown, black	5.5	O'rhm. *H.* thin tab., pyr.
Andesite† (Andesine, Feldspar group)	sub-vitreous inclining to pearly	white, gray greenish yellowish flesh-red	5.5	Trcl. *S.* gran., massive.
Gehlenite‡	greasy	green, brown	5.5	Tetrag. *H.* cuboid, thick tab., short colmn. *S.* interspersed.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Cl. i–2 (N. J.) **0** (Moresnet) both easy. *Fr.* fine granular.	Zn_2SiO_4	G. ± 4. Gelatinizes with HCl. BB glows and fuses with difficulty to white enamel. *Ch.* powder with soda gives yellow coating while hot and white on cooling. *A.* Smithsonite, Calamine, Zincite, Franklinite.
Cl. i–ī distinct i–ī less so	$(Al_2(Ca,Na_2)(SiO_4)_2)_2 \cdot 5H_2O$	G. ± 2.3. Gelatinizes with HCl. BB fuses with intumescence to white enamel, losing 13.3 p. c. of water. *A.* Natrolite, Stilbite, Calcite, Elæolite. In cavities in igneous and metamorphic rocks.
Fr. granular	$Al.Na(SiO_3)_2.H_2O$	G. 2.2. Gelatinizes with HCl. Yields water. BB fuses to colorless glass. *A.* Apophyllite, Natrolite, Phillipsite.
Cl. I perfect. *Fr.* granular.	$Al_3Na_5(Al,NaSO_4)(SiO_4)_4$	G. ± 2.3. Gelatinizes with HCl, and emits H_2S odor. BB in forceps fuses to white glass. With soda on coal, hepar reaction with silver. *A.* In trachyte, phonolite, basalt, lava. *Not with Quartz.*
Cl. I perfect. *Fr.* granular, compact.	$Al_3(Al.Cl)Na_5(SiO_4)_4$	G. ± 2.1. Gelatinizes with HCl and HNO_3. In closed tube blue varieties become white and opaque. Fuses with intumescence to colorless glass. *A.* Elæolite, Zircon, Titanite. *Not with Quartz.*
Cl. cubic, distinct	$CaTiO_3$	G. 4. BB in forceps and on coal infusible. Mercsm. salt, greenish bead hot, in O.F., colorless on cooling. R.F. changes to gray-green, and assumes violet tint on cooling. *A.* Chlorite.
Cl. I distinct I ∧ I, 104°	TiO_2	G. ± 4.2. BB infusible. With mercsm. salt, colorless bead, which, in R.F., assumes violet tint on cooling. The Fe impurity obscures the violet unless treated with tin on coal. Insoluble in acids until fused with alkali hydrate or carbonate. Acid solution gives violet color on introduction of tin foil. *A.* Rutile, Anatase, Titanite, Adularia, Quartz, Arkansite; Aplome-Garnet, Elæolite.
Cl. more uneven than Albite. *Fr.* compact.	$Al\,Na\,Si_2\,SiO_8$ $Al\,Ca\,Si_2\,AlO_8$	G. 2.68. BB fuses in thin splinters; *Saccharite* only on thin edges. Imperfectly soluble in acids. *A.* Many rocks, especially some trachytes.
Cl. **0** distinct	$(AlO)_2(Ca,Mg,Fe)_3(SiO_4)_2$	G. ± 3. Gelatinizes with HCl. BB thin splinters fuse with difficulty to a gray glass; with borax, slowly to glass colored by Fe. *A.* In granular limestone.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Andalusite (Chiastolite, Hohlspath)	feebly lustrous to earthy	gray, white, pale yellow, pale brown	5.5	O'rhm. *H.* acic., colmn.
Cyanite (Disthene, Rhäticit)	vitreous, partly pearly	blue, less frequently white, pale yellow, pale red, gray, black	± 5.5	Trcl. *H.* colmn., splintery, acic., thick scaly, flat gran. *S.* massive.
Enstatite† (Bronzit, Protobastit)	I pearly	pale gray, pale yellow, pale green, pale brown	5.5	O'rhm. *H.* acic., colmn.
Wernerite† (Scapolite, Mizzonit)	greasy, vitreous, i–i pearly	gray, white, greenish gray, dirty green, reddish gray	5.5	Tetrag. *H.* colmn., acic. *S.* massive.
Ekebergite‡ (Porzellanit, Meionit)	vitreous	white	6	Tetrag. *H.* colmn., acic.
Rhodonite† (Kieselmanganerz, Paisbergit, Bustamit, Fowlerite)	vitreous, partly pearly	raspberry-red rose-red reddish brown reddish gray	5.5	Trcl. *H.* short colmn., short acicular. *S.* massive.
Tephroite†	adamant to resinous	brownish gray reddish gray brownish red flesh-red	5.5	O'rhm. *S.* massive.
Titanite (Varieties and synonyms: Sphene, Séméline, Greenovite, Lederite, Spinthère, Pictite, Ligurite)	greasy, partly vitreous and adamantine	brown, green, yellow, black; seldom white, red	6	Mcl. *H.* colmn., thin tab., wedge form, chisel form, acic. *S.* massive.
Chloritoid (Chloritspath, Barytophyllit)	vitreous, on cleavage planes pearly	dark green, dark greenish gray	6	Mcl. *S.* massive.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions, A = Associated Minerals.
Cl. I distinct I ∧ I, 91°	$Al(AlO)SiO_4$	G. ± 3.2. BB infusible. With Co solution, blue color. Not decomposed by acids. *A.* In clay slate.
Cl. perfect in one direction, less so in a second (i–ī ∧ iĭ, 106°)	$(AlO)_2SiO_3$	G. 3.6. BB same as preceding. *A.* Staurolite, Almandite and Hessonite or Essonite (Garnets), Omphacite, Hornblende, Corundum.
Cl. I distinct I ∧ I, 88°	$(Mg,Fe)SiO_3$	G. ± 3.2. Weathers. Almost infusible. Only rounded on thin edges. Insoluble in HCl. *A.* Olivine, Apatite. In olivine rock and Serpentine.
Cl. i–i distinct, but interrupted *Fr.* large granular, compact, splintery.	$Al_2(AlCl)Na_4(Si_3O_8)$ $Al_2(AlO)Ca_4(Si_2AlO_8)$	G. ± 2.7. Weathers. Fuses easily with intumescence to white blebby glass. Decomposable by HCl. *A.* Calcite, Magnetite, Augite, Hornblende, brown Titanite, Epidote.
Cl. i–i distinct, but interrupted	$Al_2(AlO)Ca_4(Si_2AlO_8)_3$	G. 2.7. In closed tube yields small amount of water. BB, like preceding. *A.* Sanidine, Nephelite, Augite. On limestone.
Cl. perfect in two direct., I ∧ I, 88°. *Fr.* shelly, gran., compact, splintery.	$MnSiO_3$ $(Mn,Ca)SiO_3$	G. ± 3.5. BB blackens and fuses with slight intumescence. Amethyst glass with borax. *Fowlerite* gives *ch.* with soda reaction for Zn. In powder partially dissolves in HCl, and insoluble portion becomes white. Darkens on exposure to air. *A.* Hausmannite, Braunite, Magnetite, Franklinite, Zincite, Calcite, Pyroxene, Aplome-Garnet.
Cl. perfect in one direction, distinct in another. *Fr.* gran., compact.	Mn_2SiO_4	G. ± 4.6. Gelatinizes without evolving Cl. BB fuses at 3.5 to a black scoria. *A.* Magnetite, Franklinite, Zincite, Calcite.
Cl. I sometimes. *Fr.* shelly.	$CaSiTiO_5$	G. ± 3.5. BB some varieties change color and fuse with intumescence to a yellow, brown, or black glass. With borax, a clear yellowish-green glass. Imperfectly soluble in hot HCl. With tin in concentrated acid, a violet color; with mercsm. salt, in R.F., violet bead masked when Fe is present, if not treated with tin. *A. Sphene* imbedded in clefts of older slates. Albite, Adularia, Chlorite, Rutile. *Sémêline* in phonolite, etc. *Brown Titanite* in hornblende slate, syenite, diorite, etc., as also in Magnetite deposits.
Cl. 0 perfect. *Fr.* thin shelly, scaly.	$Al_2(Fe,Mg)H_2SiO_7$	G. ± 3.5. In matrass yields water. BB nearly infusible. Becomes darker and magnetic. *A.* Corundum, Almandite, Chlorite, Amphibole.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Diopside (Sahlite, Malakolith. Var. Pyroxene)	vitreous	green, white, yellow	6	Mcl. *H.* colmn., acic., splintery, acute pyramidal. *S.* massive.
Leucite	vitreous to resinous	gray, white	6	Isom. and Tetrag. (?) (dimorphic). *S.* interspersed.
Tremolite (Grammatite, Calamite, Nephrite or Jade. Variety Amphibole)	vitreous, silky	white, greenish gray	6	Mcl. *H.* colmn., acic. *S.* massive.
Omphacite (Allied to Fassaite. Var. Pyroxene)	vitreous	grass-green leek-green	6	Mcl. *S.* massive.
Diaspore	vitreous i–ĭ pearly	white	6	O'rhm. *H.* tabular, broad columnar. *S.* massive.
Turquois† (Callaite, Kallait)	glinting	blue, green	6	Cryptocrystalline. *S.* intersp., masv., incrusted, lamel., small reniform.
Helvite‡ (Helvin)	resinous	yellow, brown	6	Isom. *H.* tetrahedral.
Hyalite‡ (Var. Opal)	vitreous, seldom pearly	white	6	Amorphous. *S.* small botrydl., small reniform, stalact., incrusted.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Cl. I perfect I ∧ I, 87°	$MgCa(SiO_3)_2$ $(Mg,Fe)Ca(SiO_3)_2$	G. ± 3.3. Often many facets. BB with difficulty fusible. Crystal sometimes divided by basal plane into a green and a white half. In clefts of chlorite slate, hornblende slate, and serpentine. *A.* (*Diopside*) Hessonite-Garnet, Chlorite. (*Sahlite*) Magnetite, Pyrite, Chalcopyrite, Blende, Galenite, Calcite, Chlorite.
Cl. icositetrdl.	$AlK(SiO_3)_2$	G. ± 2.5. Crystals always seem isom. BB almost infusible. With Co solution gives blue color. Decomposed by HCl without gelatinizing. In lava, leucitophyr, etc. *A.* Sanidine, Nephelite, Augite, Melanite-Garnet. Seldom imbedded.
Cl. I perfect I ∧ I, 124°. *Fr.* stalky, fibr., radial, felty.	$Mg_3Ca(SiO_3)_4$	G. ± 3.2. Crystals with terminal facets extremely rare. With difficulty fusible. *A.* In the older limestones and dolomites.
Cl. in two directions. In one perfect, in the other distinct. *Fr.* granular.	$Mg,Ca(SiO_3)_2$	G. ± 3.2. BB easily fusible. *A.* Hessonite-Garnet, Hornblende, Cyanite, Saussurite.
Cl. i-ī perfect. *Fr.* thin shelly, broad stalky, fibr., radial.	$AlO.OH$	G. ± 3.4. In closed tube decrepitates strongly, separating into pearly white scales, and finally yields water. BB infusible. With Co solution, deep blue. Some varieties react for iron. Not attacked by acids, but after ignition soluble in H_2SO_4. Trichromatic. *A.* (1) Chlorite, Magnetite. (2) In Lithomarge.
Fr. conchoidal to uneven, compact	$Al_2(OH_3)PO_4.H_2O$	G. ± 2.7. Soluble in HCl. In closed tube decrepitates, yields water, and turns brown and black. BB in forceps becomes brown and glassy, but does not fuse. Colors flame green. With borax, in O.F., yellowish-green bead, pure green on cooling. *A.* In Quartz slate.
.....	$(Mn,Be,Fe)_7S(SiO_4)_3$	G. ± 3.2. Decomposed by HCl with evolution of H_2S and separation of gelatinous silica. BB fuses in R.F. to yellowish-brown opaque bead with intumescence. Reacts for Mn. *A.* Aplome-Garnet, Galenite, Blende, Calcite.
Fr. conchoidal	$SiO_2(H_2O)_x$	G. ± 2. Clear as glass and colorless, constituting globular concretions. BB infusible. *A.* In basalt, phonolite, etc.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Spodumene† (Triphan, Hiddenite)	vitreous i–ĭ pearly	gray, white, green	6	Mcl. *H.* columnar. *S.* massive.
Augite (Variety of Pyroxene)	vitreous	grayish and greenish black	6	Mcl. *H.* long and short colmn., acicular, thick tabular. *S.* masv., intersp.
Hypersthene† (Paulit)	vitreous, resinous, i–ĭ metalloid, pearly	blackish brown brownish black i–ĭ copper-red	6	O'rhm. *H.* short acicular. *S.* intersp., masv.
Octahedrite† (Anatase)	adamantine, metalloid in part	in all colors, most frequently red, black; *not white*	6	Tetrag. *H.* pyr., thick tabular, colmn.
Nephelite‡ (Nephelin, Elæolite)	vitreous resinous	white, gray, pale yellow, brown, green, red	6	Hex. *H.* short acicular, short columnar, thick tabular. *S.* masv., intersp.
Orthoclase (Potassium Felspar. Pegmatit, Adularia Sanidin)	vitreous, 0 generally pearly	white, red, gray, yellow, brown	6	Mcl. *H.* colmn., short acic., tabular, like rhombohedron. *S.* masv., intersp.
Albite (Cleavelandite, Sodium Felspar, Periklin, Hyposklerit)	vitreous 0 pearly	generally white or red	6	Trcl. *H.* colmn, radial, compact. *S.* masv., intersp.
Oligoclase (Calcium-Sodium Felspar. Varieties Aventurine or Sunstone, Moonstone)	resinous 0 vitreous seldom pearly	most frequently green, white, gray, red	6	Trcl. *H.* colmn., thick tabular. *S.* masv., intersp.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS, Sp. Gr., Reactions. A = Associated Minerals.
Cl. i–ī distinct I less so I ∧ I, 87°. *Fr.* broad stalky, thick shelly, compact.	$Al(Li,Na)(SiO_3)_2$	G. 3.1. BB becomes white and opaque; swells up, and gives red color to flame. Fuses to a clear or white glass. Not dissolved by acids. *A.* Tourmaline. In granite.
Cl. I distinct I ∧ I, 87°. *Fr.* gran., compact.	$Al_2O_3.Mg\,Al.SiO_3$	G. ± 3.3. BB with some difficulty fusible to a bead. *A.* In basalt, basalt tufa, dolerite, phonolite, andesite, melaphyre, etc. *Not with Quartz.*
Cl. i–ī distinct. *Fr.* compact.	$(Mg,Fe)SiO_3$	G. ± 3.4. Crystals very rare. BB fuses to a black enamel, and *ch.* yields magnetic mass. *A.* Olivine, Amphibole, Magnetite, Titanite, in Hypersthenite. *Not with Quartz.*
Cl. 0 perfect I distinct	TiO_2	G. ± 3.9. Soluble in HCl. BB infusible. With mercsm. salt, in R.F., bead, which becomes violet on cooling. *A.* Rutile, Titanite, Albite, Adularia, Quartz, Chlorite, Fluorite.
Cl. I distinct 0 distinct. *Fr.* compact.	$Al_8(Na_2,K_2,Ca)_4Si_9O_{34}$	G. ± 2.6. Weathers. Gelatinizes with acids. BB fuses quietly to a colorless glass. *A.* In nephelinite, basalt, phonolite, lava, syenite. *Not with Quartz.*
Cl. 0 perfect i–ī distinct. *Fr.* gran., compact, splintery.	$Al(K,Na)Si_3O_8$	G. ± 2.5. Never shows multiple twin striation on 0. Sometimes play of colors. BB fuses with great difficulty. Varieties containing Na are much more fusible. Not acted upon by acids. *A.* Quartz, Muscovite, in granite, gneiss, porphyry, and many rocks. *Seldom or never Pyroxene.*
Cl. 0 perfect i–ī distinct ½ less so. *Fr.* gran., radial, compact.	$Al(Na,K)Si_3O_8$	G. ± 2.6. Often showing multiple twin striation on 0. BB fuses to a colorless or white glass imparting yellow color to flame. *A.* Adularia, Quartz, Smoky quartz, Chlorite, Rutile, Titanite, Pistacite, Apatite. In diorite, granite. In clefts of gneiss and granite.
Cl. 0 perfect i–ī distinct. *Fr.* gran., compact, splintery.	$Al\,Na\,Si_2SiO_8$ $Al\,Ca\,Si_2AlO_8$	G. 2.56. Generally multiple twin striation on 0. BB fuses at 3.5 to a clear enamel. Not affected by acids. *A.* In diabase, granite. In magnetite beds.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Labradorite (Sodium-calcium Felspar)	vitreous to resinous, **0** pearly	white, gray, brown	6	Trcl. *H.* colmn., thick tabular. S. masv., intersp.
Anorthite (Calcium Felspar, Indianite)	vitreous **0** pearly	white, gray, red	6	Trcl. *H.* short acicular, thick tabular. *S.* masv., intersp.

5. Very

Prehnite (Edelite, Jacksonite)	vitreous **0** pearly	green, pale green	6.5	O'rhm. *H.* tabular, short colmn., short acic. *S.* spherical, reniform, botryoidal, massive.
Epidote (Pistacite. Dimorphic with Zoisite)	vitreous pearly in part	green, brown, yellow, gray; seldom red	6.5	Mcl. *H.* colmn., acic. *S.* masv., intersp., lamellar, coating.
Zoisite (Saussurite in part)	vitreous i–ĭ pearly	gray, red, green, white	6.5	O'rhm. *H.* colmn., acic. *S.* massive.
Allanite (Orthite)	vitreous pearly in part	black, dark gray	6.5	Mcl. *H.* colmn., acic., tabular. *S.* masv., intersp.
Chondrodite (Humite)	vitreous to resinous	yellow, brown	6.5	Mcl. *Humite* O'rhm. *S.* masv., intersp.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Cl. **0** perfect i–i less so. *Fr.* gran., compact, splintery.	$AlNaSi_2SiO_8$ $AlCaSi_2AlO_8$	G. ± 2.7. Crystals rare. On 0 generally multiple twin striation and beautiful play of colors. BB fuses to colorless glass. Decomposed with difficulty by HCl, and generally but partially. *A.* In basalt, gabbro. *Not* with Quartz nor Muscovite.
Cl. **0** perfect i–i perfect. *Fr.* gran., compact.	$AlCaSi_2AlO_8$	G. ± 2.76. Crystals generally small and with many facets. BB fuses to colorless glass. From Mt. Somma decomposed by HCl with separation of silica. *A.* In gran. limestone.

Hard.

Cl. **0** perfect I distinct I ∧ I, 100°. *Fr.* radial, gran.	$Al_2Ca_2H_2(SiO_4)_3$	G. ± 2.8. Decomposed by HCl without gelatinizing. In closed tube yields water. BB fuses with intumescence to blebby enamel-like glass. *A.* Calcite, Datolite.
Cl. perfect in one direction; less so in another	$Al_2(Al.OH)Ca_2(SiO_4)_3$	G. 3.2–3.5. Partially decomposed by HCl, but when first ignited gelatinizes with acid. In closed tube generally gives water. BB fuses with intumescence to dark brown or black mass, which is generally magnetic. Reacts for Fe and sometimes for Mn with fluxes. *A.* (1) In clefts of hornblendic rocks. (2) Chlorite slate. (3) The older limestone and magnetite beds. (4) In clefts and amygdaloids of melaphyre.
Cl. perfect in one direction. *Fr.* stalky.	$Al_2(Al.OH)Ca_2(SiO_4)_3$	G. ± 3.2. Crystals generally without terminal planes. Not decomposed by acids. Previously ignited gelatinizes with HCl. BB swells up and fuses to white blebby mass. *A.* Hornblende, Hessonite garnet, Epidote, Cyanite.
Fr. compact, conchoidal	$(Al,Ce,Fe)_2(Al.OH)(Ca,Fe)_2(SiO_4)_3$	G. 3–4.2. Most varieties gelatinize with HCl. Some varieties give water in closed tube. BB fuses easily, and swells to a dark blebby magnetic glass. With fluxes reacts for iron. *A.* Magnetite, Hessonite. On granite, syenite, trachyte. In the older limestones.
Fr. granular	$(Mg.OH)_2(MgFl)_4(Mg,Fe)_{12}(SiO_4)_5$	G. ± 3.1. Crystals generally small and with many facets. Gelatinizes with acids. BB infusible. Some varieties blacken and then burn white. Fused with mercsm. salt, in open tube, reacts for F; with fluxes, reaction for Fe. *A.* Magnetite, Blende, Chalcopyrite, Galenite, Spinel, Amphibole, Biotite, Graphite. In deposits of the older limestones.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Rutile (Ilmenorutile)	adamantine	red, brown	6.5	Tetrag. *H.* colmn., acic., capillary. *S.* masv., intersp.
Cassiterite (Zinnstein, Zinnerz)	adamantine resinous	black, gray, brown. Seldom yellow, red, white	6.5	Tetrag. *H.* colmn., acic., pyramidal. *S.* masv., intersp.
Fibrolite (Sillimanite). Dimorphic with Cyanite	resinous vitreous	gray, brown, green	6.5	O'rhm. *H.* acic., colmn. *S.* massive.
Peridot (Olivine, Chrysolite)	vitreous resinous	green, yellow, brown	7	O'rhm. *H.* short acicular, short colmn., tab. *S.* masv., intersp.
Obsidian (Including Pumice, Volcanic Glass). A rock	vitreous seldom silky	black, gray, white, brown	7	Amorphous
Quartz (Silex, Kiesel)	vitreous; on surfaces of fracture resinous	in all colors; mostly white and gray	7	Hex. *H.* colmn., acic., pyr., seldom r'dl. *S.* masv., intersp., lamel., incrust'ns.
Chalcedony (Flint. Varieties of Quartz)	on planes of fracture glinting to earthy	in all colors, and frequently many in the same specimen	7	Cryptocrystalline. *S.* reniform, stalactitic, globular, botrydl., nodular, lamel., incrust'ns.
Vesuvianite† (Idocrase)	resinous, partly vitreous	brown, gray, yellow; seldom red	7	Tetrag. *H.* colmn., acic., tabular, pyr. *S.* massive.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Cl. i–i perfect I distinct. *Fr.* compact, gran.	$TiTiO_4$	G. ± 4.2. BB infus. With mercsm. salt colorless bead, which, in R.F., becomes violet on cooling. *A.* (1) In the older slates. (2) In clefts of latter. Titanite, Adularia, Albite, Quartz, Chlorite. (3) In deposits of Apatite, Magnetite.
Cl. i–i perfect I distinct. *Fr.* compact, gran., fine fibrous.	SnO_2	G. 6.4–7.1. Generally in twins. But slightly acted upon by acids. BB alone unaltered. With soda in R.F., white coat. *A.* (1) In the older slates and old eruptive rocks. (2) In tin veins. Arsenopyrite, Wolframite, Scheelite, Molybdenite, native Bismuth. Fluorite, Apatite, Lepidolite, Chlorite. (3) Deposits of Pyrite, Blende, etc. Aplome-Garnet, Pyroxene.
Cl. i–ī perfect. *Fr.* fibr., compact, splintery.	$Al(AlO)SiO_4$	G. ± 3.2. Not decomposed by acids. BB infusible. With Co solution gives a blue color. *A.* Cordierite, Zircon. In gneiss.
Cl. distinct in two directions. *Fr.* gran., compact.	$(Mg,Fe)_2SiO_4$	G. ± 3.4. Decomposed and gelatinizes with HCl and H_2SO_4. BB whitens, but is infusible. With fluxes gives reactions for Fe. Some varieties give reaction for Ti and Mn. (1) Occurs as a rock. (2) In basalt, gabbro, talc slate. *A.* Biotite, Bronzite, Hypersthene, Diallage, Garnet, and Magnetopyrite. *Not with Quartz.*
Fr. conchoidal, compact, porous	$KNa_3Al_2Si_{10}O_{25}$	G. 2.25–2.8. Principally Orthoclase in glassy state. Sometimes a mixture of Orthoclase, Labradorite, and Augite with Chrysolite and much iron. Splinters exceedingly sharp edged. Very brittle. BB difficult to fuse to bead. Occurs as a rock, and *A.* Perlite.
Cl. R very seldom distinct. *Fr.* conchoidal, compact, splintery, stalky, fibr., gran.	SiO_2	G. ± 2.7. Generally horizontal striations on I. BB alone unaltered. With soda dissolves with effervescence. Unacted upon by mercsm. salt. Soluble only in HF. *A.* Very widely distributed.
Fr. in the large, even to conchoidal; in the small, fine splintery	SiO_2	G. ± 2.7. BB, see Quartz. Either transparent or translucent. *A.* (1) In clefts and rounded cavities of Melaphyre. Quartz, Zeolites, Calcite. (2) In ore veins. (3) Deposits of Siderite and Limonite. (4) Flint in chalk.
Fr. stalky, gran., compact, splintery	$Al_{12}Ca_{24}(OH)_{10}Si_{20}O_{77}$	G. ± 3.4. Crystals often show many facets. BB fuses with intumescence to a greenish or brownish glass. With fluxes gives iron reaction. After ignition completely decomposed by HCl. *A.* In older limestones and deposits of Magnetite, Pyrite, Magnetopyrite, Blende, Galenite, Pyroxene, Aplome-Garnet, Chlorite, Biotite.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Garnet (Carbunculus. Varieties: Grossularite Ca-Al garn., Pyrope Mg-Al garn., Almandite Fe-Al garn., Spessartite Mn-Al garn., Andradite (or Aplome) Ca-Fe garn., Bredbergite Ca-Mg-Fe garn., Uwarowit Ca-Cr garn.)	vitreous resinous	in all colors *but blue;* most frequently red, brown, green, black	7	Isom. *H.* dodecahedral, icositedrahedral. *S.*
Axinite‡ (Thumite)	vitreous, partly adamantine	brown, gray	7	Trcl. *H.* tabular. *S.* massive.
Tourmaline (Schörl. Var. I. is brown. Var. II. is red)	vitreous	in all colors; principally black brown, and green	7	Hex. *H.* r'dl., colmn., acicular. *S.* masv., intersp.
Iolite‡ (Cordierite, Dichroite)	vitreous resinous	blue, green, gray, brown	7	O'rhm. *H.* columnar. *S.* masv., intersp.
Boracite‡ (Parasit, Stasfurtit). Dimorphic	vitreous adamantine	white, gray, greenish	7	Isom. and O'rhm. *H.* hexdrl., dodcl., tetrdl.
Andalusite† (Chiastolite). Dimorphic with Cyanite	vitreous resinous	red, gray, brown	7	O'rhm. *H.* colmn., acic. *S.* massive.
Staurolite† (Granatite, Staurotide)	vitreous	reddish brown black-brown black	7.5	O'rhm. *H.* colmn., acic.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A = Associated Minerals.
Fr. compact, splintery, granular	Ca-Al G.–$Al_2Ca_3(SiO_4)_3$ Ca-Fe " $Fe_2Ca_3(SiO_4)_3$ Ca-Cr " $Ca_3Cr_2(SiO_4)_3$ Fe-Al " $Al_2Fe_3(SiO_4)_3$	G. 3.1–4.3. Most varieties fuse easily to light-brown or black glass. Almost all varieties react for Fe. The other reactions vary with the bases. Almost all are decomposed after ignition by HCl, and usually with separation of gelatinous silica. *A.* Almandite, Spessartite in the older slates and in granite. Melanite in basalt, nephelinite, Leucitite, etc. Aplome in deposits of Magnetite, Pyrite, Blende, Galenite, etc. Pyrope in Serpentine. Grossularite (Hessonite) in older limestones, imbedded in older slates, constituent of Eklogite; in deposits of Magnetite.
Fr. shelly	$H_2(Ca,Fe,Mn)_4$ $BO(Al,Fe)_3(SiO_4)_5$	G. ± 3.3. Not decomposed by acids. Gelatinizes with HCl. Fuses easily with intumescence, and imparts pale green to flame, and fuses to dark-green to black glass. With borax an amethyst-colored bead in O.F. Fused with $KHSO_4$ and fluorite on platinum wire gives green flame. *A.* In clefts of Hornblende slate, diorite, etc. In deposits of Blende, Arsenopyrite, etc.
Fr. conchoidal, stalky, fibr., gran.	$(Mg,Fe,Na_2,Li_2,H_2$ $(AlO)_2)_9Si_4B_2O_{20}$	G. 2.9–3.3. Dichroic. Pyroelectric. Rubellite infusible, but becomes paler. Not decomposed by acids. BB most varieties fuse with intumescence, and give reaction for Fe and Mn, and with mixture of $KHSO_4$ and CaF_2 strong reaction for boracic acid. After fusion perfectly decomposed by H_2SO_4 and gelatinizing with HCl. *A.* Almandite, Beryl, Topaz. In older slates. In and on granite.
Cl. 0 distinct i–i distinct. *Fr.* compact.	$(Al,Fe)_6Mg_2Si_5O_{28}$	G. ± 2.6. Only partially decomposed by acids. BB loses transparency and fuses. *A.* Almandite, Schörl. In gneiss, granulite, granite.
Cl. of isom. octdl. in traces. *Fr.* conchoidal.	$Mg_7Cl_2B_{16}O_{30}$	G. ± 3. Massive variety gives water in closed tube. BB fuses to white crystalline pearls, coloring flame green. With Co solution assumes deep-pink color. Mixed with CaO and heated on coal gives flame deep-blue color. *A.* Gypsum, Anhydrite.
Cl. I perfect I ∧ I, 91°. *Fr.* stalky, fibrous, compact, splintery.	$Al(AlO)SiO_4$	G. ± 3.1. Weathering. BB infusible. With Co solution, a blue color. Not decomposed by acids. *A.* Almandite, Tourmaline, Rutile. In the older slates, granite.
Cl. i–i distinct	$(AlO)_4Fe(AlOH)(SiO_4)_2$	G. ± 3.6. Often in twins. BB infusible, except the Mn variety, which fuses to a black magnetic glass. With fluxes reacts for Fe and sometimes for Mn. Imperfectly decomposed by H_2SO_4. *A.* Almandite, Cyanite. In mica slate.

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NAME.	LUSTRE.	COLOR.	HARD'SS.	CRYSTAL SYSTEM, HABIT, AND STRUCTURE.
Beryl† (Emerald)	vitreous	green, blue, white, yellow, red	7.5	Hex. *H.* colmn., acic. *S.* massive.
Zircon† (Hyacinth)	adamantine resinous	colorless, and in all colors, especially brown, yellow, and gray	7.5	Tetrag. *H.* colmn., acic., pyramidal. *S.* interspersed.
Chrysoberyl† (Alexandrite)	vitreous resinous	green, yellow	8	O'rhm. *H.* thick tabular, short colmn., pyr. *S.* interspersed.
Spinel† (Picotite)	vitreous resinous	black, red, green, blue, brown	8	Isom. *H.* octahedral. *S.* interspersed.
Topaz (Topazius, Pyrophasalite, Phasalite, Pycnite)	vitreous, adamantine, and on **0** pearly	yellow, pale blue, white, pale green, pale red	8	O'rhm. *H.* colmn., acic. *S.* intersp., masv.
Corundum† (Ruby, Sapphire)	vitreous resinous	blue, red, green, gray, brown, white	9	Hex. *H.* colmn., thick tab., pyr., rhmbdl. *S.* masv., intersp.
Diamond† (Adamas)	adamantine	in all colors, most frequently white, gray, yellowish, brownish	10	Isom. *H.* octdrl., dodcl., hexhdrl. *S.* masv., intersp., seldom globular.

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CLEAVAGE AND FRACTURE.	CHEMICAL FORMULA.	REMARKS. Sp. Gr., Reactions. A — Associated Minerals.
Cl. **0** distinct I less so. *Fr.* stalky.	$Al_2Be_3(SiO_3)_6$	G. ± 2.7. BB unchanged or becomes clouded. Glass with borax, clear for beryl; fine green for emerald. Slowly soluble with mercsm. salt without leaving siliceous skeleton. Undissolved by acids. *A.* Tourmaline, Topaz, Triphyline. In mica slate, chlorite slate, and in granite. In tin ore veins.
Cl. I distinct. *Fr.* compact.	$ZrSiO_4$	G. 4–4.7. Infusible. The colorless varieties are unaltered; the red becomes colorless. Not perceptibly attacked by mercsm. salt. Powder is decomposed by fusion with soda on platinum wire, and if the product is dissolved in dilute HCl, gives the characteristic orange color with turmeric paper. *A.* In eruptive rocks, both the older granite, syenite, and the newer basalt. In clefts of the older slates with Diopside, Garnet, Chlorite.
Fr. compact	$BeAl_2O_4$ or $Be(AlO_2)_2$	G. ± 3.7. Crystals often seem hex. Insoluble in acids. BB alone unaltered. With soda the surface is merely rendered dull. With borax or mercsm. salt fuses with great difficulty. With Co solution the powder gives a bluish color. *A.* Beryl, Phenacite, Almandite, Tourmaline. In mica slate and granite.
Fr. compact	$MgAl_2O_4$ or $Mg(AlO_2)_2$	G. 3.5–4.9. Sometimes in twins. BB alone infusible. Red variety changes to brown or black, and becomes opaque. On cooling becomes green, then nearly colorless, and finally resumes its red color. Slowly soluble in borax and mercsm. salt, with which it gives reddish bead, becoming green by cooling. Soluble with difficulty in H_2SO_4. *A.* Pyroxene, Chondrodite, Biotite, Graphite. In the older limestones. In basalt and talc slate.
Cl. **0** perfect. *Fr.* stalky.	$Al(Al(F_2O))SiO_4$	G. ± 3.5. BB infusible. Some varieties take a wine-yellow or pink tinge when heated. Fused in open tube with mercsm. salt gives reaction for F. With Co solution the powder gives fine blue. Only partly attacked by H_2SO_4. *A.* In tourmaline slate, in and on granite. On tin ore deposits.
Cl. R distinct **0** distinct. *Fr.* gran., compact, splintery.	Al_2O_3	G. ± 4. BB unaltered. Slowly dissolved in borax and mercsm. salt to a clear glass, which is colorless when free from iron. Not acted upon by soda. Finely powdered mineral gives blue color with Co solution. Not acted upon by acids. Friction develops electricity. *A.* In independent deposits. Magnetite, Chlorite. In older limestones and granite. In basalt.
Cl. 1 highly perfect	C	G. 3.5. Crystals often rounded. Burns to CO_2. Is not acted upon by acids or alkalies. Almost always loose. In washings, with decomposed Peridot.

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TABLE OF ELEMENTS.—(1891.)

[The atomic weights are calculated on the basis of O = 16.]

NAME.	Symbol.	Atomic Weight.	Apparent Valences and Molecule.*	State.†	Discoverer.	Date.
Aluminum	Al	27.	III	Solid	Woehler	1828
Antimony	Sb	120.	III, v	"	Valentine	1460
Arsenic	As	75.	III, v, Tetratomic (?)	"	Schroeder	1694
Barium	Ba	137.	II	"	Davy	1808
Beryllium (or *Glucinum*)	Be or G	9.	II	"	Woehler	1828
Bismuth	Bi	208.9	III, v	"	Agricola	1529
Boron	B	11.	III	"	Davy	1807
Bromine	Br	79.95	I, iii, v, vii	Liquid	Balard	1826
Cadmium	Cd	112.	II, Monatomic	Solid	Stromeyer	1817
Caesium	Cs	132.9	I, iii (?)	"	Bunsen	1860
Calcium	Ca	40.	II	"	Davy	1808
Carbon	C	12.	IV	"	Ancients	.....
Cerium	Ce	140.2	II, iv, iii (?)	"	Berz. and Hisinger	1803
Chlorine	Cl	35 45	I, iii, v, vii	Gas	Scheele	1774
Chromium	Cr	52.1	II, iv, iii	Solid	Vauquelin	1797
Cobalt	Co	59.	II, iv, iii	"	Brandt	1733
Copper	Cu	63.6	II, i (?)	"	Ancients	.....
‡Didymium?	D	142.3	II	"	Mosander	1841
Erbium	Er	166.	III	"	Mosander	1843
Fluorine	F	19.	I	Gas	Knox (?)	1836
Gallium	Ga	69.	III	Solid	de Boisbaudran	1875
Germanium	Ge	72.3	IV	"	Winkler	1886
Gold	Au	197.3	III	"	Ancients	.....
Holmium	Ho (?)	162.	III	"	Cleve	1879
Hydrogen	H	1. ‖	I	Gas	Cavendish	1766
Indium	In	113.7	III	Solid	Reich and Richter.	1863
Iodine	I	126.85	I, iii, v, vii	"	Courtois	1812
Iridium	Ir	193.1	ii, IV, iii (?)	"	Tennant	1804
Iron	Fe	56.	II, iv, iii	"	Ancients	.....
Lanthanum	La	138.2	II	"	Mosander	1839
Lead	Pb	206.95	II, iv	"	Ancients	.....
Lithium	Li	7.02	I	"	Davy	1818
Magnesium	Mg	24.3	II	"	Davy	1808
Manganese	Mn	55.	II, iv, iii, vii	"	Gahn	1774
Mercury	Hg	200.	II, Monatomic	Liquid	Ancients	.....
Molybdenum	Mo	96.	ii, iv, VI, v (?)	Solid	Hjelm	1782

* Elements not otherwise marked are presumed to have a diatomic molecule.
† At ordinary temperatures.
‡ Probably mixture of Neodidymium (Nd) 140.8, and Praseodidymium (Pr) 143.6.
‖ Accurately 1.007 if O = 16.

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NAME.	Symbol.	Atomic Weight.	Apparent Valences and Molecule.*	State.†	Discoverer.	Date.
Nickel	Ni	58.7	II, iv	Solid	Cronstedt	1751
Niobium (or *Columbium*)	Nb or Cb	94.	V	"	Hatchett	1801
Nitrogen	N	14.03	III, v	Gas	Rutherford	1772
Osmium	Os	190.8	ii, IV, iii, vii	Solid	Tennant	1803
Oxygen	O	16.	II, Diatomic and Triat.	Gas	Priestley	1774
Palladium	Pd	106.6	ii, IV	Solid	Wollaston	1803
Phosphorus	P	31.	III, v, Tetratomic	"	Brandt	1669
Platinum	Pt	195.	ii, IV, viii	"	Wood	1741
Potassium	K	39.11	I, iii	"	Davy	1807
Rhodium	Ro	103.	ii, IV, iii, viii	"	Wollaston	1803
Rubidium	Rb	85.5	I, iii (?)	"	Bunsen	1860
Ruthenium	Ru	101.6	ii, IV, iii, vii	"	Claus	1845
‡Samarium (?)	Sm	150.	III	"	de Boisbaudran	1888
Scandium	Sc	44.	III	"	Nilson	1879
Selenium	Se	79.	II, iv, vi	"	Berzelius	1817
Silicon	Si	28.4	IV	"	Berzelius	1823
Silver	Ag	107.92	I	"	Ancients	.....
Sodium	Na	23.05	I, iii (?)	"	Davy	1807
Strontium	Sr	87.6	II	"	Davy	1808
Sulphur	S	32.06	II, iv, vi	"	Ancients	.....
Tantalum	Ta	182.6	V	"	Ekeberg	1802
Tellurium	Te	125.	II, iv, vi	"	Klaproth	1798
Terbium (?)	Tb	159.5	III	"	Mosander	1843
Thallium	Tl	204.18	I, iii	"	Crookes	1861
Thorium	Th	232.6	IV	"	Berzelius	1829
Thulium (?)	Tm	170.4	III	"	Cleve	1879
Tin	Sn	119.	ii, IV	"	Ancients	.....
Titanium	Ti	48.	IV	"	Klaproth	1794
Tungsten	W	184.	iv, VI, v	"	De Luyart	1786
Uranium	U	239.6	ii, iv, vi	"	Péligot	1841
Vanadium	V	51.4	iii, $(V_2)^{iv}$, V, $(V_2)^{viii}$	"	Sefstroem	1830
Ytterbium	Yb	173.	iv, III	"	Marignac	1872
‡Yttrium (?)	Y	89.1	III, iv (?)	"	Woehler (?)	1843
Zinc	Zn	65.3	II	"	Mentioned by Paracelsus	1540
Zirconium	Zr	90.6	IV	"	Berzelius	1824

* Elements not otherwise marked are presumed to have a diatomic molecule.
† At ordinary temperatures.
‡ Never certainly isolated.

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MOHS'S SCALE OF HARDNESS.

DEGREE.	
1	Talc.
2	Gypsum or Halite.
3	Calcite.
4	Fluorite.
5	Apatite (crystallized variety).
6	Feldspar (Adularia).
7	Quartz.
8	Topaz.
9	Corundum.
10	Diamond.

SCALES OF FUSIBILITY.

PLATTNER'S.

1. Such as fuse to a bead. (*a*) Easily. (*b*) With difficulty.
2. Such as fuse only on the edge. (*a*) Easily. (*b*) With difficulty.
3. Such as are infusible.

VON KOBELL'S.

1. *Stibnite.*—Fusible in candle flame in coarse splinters.
2. *Natrolite.*—Fusible in candle flame in fine splinters. Easily fused before the blow-pipe in coarse fragments.
3. *Almandite*, or Iron Alumina Garnet.—Infusible in candle flame, quite fusible before the blow-pipe in coarse fragments.
4. *Actinolite.*—Fusibility less than Almandite and greater than No. 5; fusible in coarse splinters.
5. *Orthoclase.*—Fusible in fine splinters.
6. *Bronzite.*—Only rounded on the edges in very fine splinters.

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INDEX.

[The names indented are of Sub-species or of Synonyms.]

Acanthite, 24.
  Adamas, 106.
Adamite, 76.
  Adularia, 98.
  Agalmatolite, 60.
  Agricolit, 86.
Alabandite, 26, 52.
  Alaunspath, 80.
Albite, 98.
  Alexandrite, 106.
Allanite, 100
Allophane, 76.
  Almandite, 104.
  Alstonite, 80.
Altaite, 8.
  Alum, 62.
Aluminite, 58.
Alunite, 80.
Alunogen, 64,
Amalgam, 8.
  Amber, 68.
Amblygonite, 90.
  Ammonia alum, 64.
  Amphibole, 54, 96.
  Analcim, 92.
Analcite, 92.
  Anatase, 98,
Andalusite, 94, 104.
  Andesine, 92.
Andesite, 92.
  Andradite, 104.
Anglesite, 74.
Anhydrite, 74.
Ankerite, 82.
Annabergite, 48, 66.
Anorthite, 100.
Anthracite, 30.
  Antimonblende, 36.
  Antimonfahlerz, 20, 26.
  Antimonglanz, 14.
  Antimonite, 14.
  Antimonnickel, 2.
  Antimonnickelkies, 10.
  Antimonsilber, 8.
Antimony, 8.
Apatite, 88.
Aplome (Ca-Fe garnet), 104.
Apophyllite, 86.
Aragonite, 80.
Argentite, 14.
  Arkansite, 92.
  Arquerite, 8.
  Arsenblüthe, 66.
  Arseneisensinter, 42.
  Arsenfahlerz, 20.
Arsenic, 20.
  Arsenikalkies, 10.
  Arseniksinter, 80.
  Arsenkies, 10.
  Arsenkupfer, 8.
  Arsennickel, 2.
  Arsennickelkies, 10, 20.
Arsenolite, 72.
  Arsenolith, 72.
Arsenopyrite, 10.
  Asbestos (Serpentine), 62.
Asbolite, 30.
Asphaltum, 30, 34.
Atacamite, 52.
Augite, 54, 98.
Aurichalcite, 64.
Autunite, 42.
  Aventurine, 98.
Axinite, 104.
Azurite, 56.

Barite, 74.
  Barytes, 74.
Barytocalcite, 80.
  Barytophyllit, 94.
Basaltic Hornblende, 46.
Beauxite, 74.
  Bernstein, 68.
Berthierite, 18.
Beryl, 106.
  Berzelite, 72.
Bieberite, 68.
Biotite, 66.
Bismuth, 6.
Bismuthinite, 16.
Bismutite, 82.
  Bismutosphärit, 82.
  Bittersalz, 66.
  Bitterspath, 82, 84.
Bituminous coal, 30.
  Black Jack, 82.
  Blättertellurerz, 12, 22.
  Blaueisenerz, 54, 66.
  Blauspath, 90.
  Bleiantimonglanz, 16.
  Bleiarsenglanz, 20.
  Bleiglanz, 16.
  Bleihornerz, 72.
  Bleilasur, 56.
  Blende, 30, 34, 82.
  Blue stone, 66.
  Blue vitriol, 66.
Bog manganese, 32.
  Bol, 62.
Boracite, 104.
Borax, 64.
  Boric acid, 60.
Bornite, 2, 4.
  Boronatrocalcit, 58.
  Botryolit, 88.
Boulangerite, 18.
Bournonite, 18, 24.
  Braunbleierz, 76.
  Brauneisenerz, 34.
Braunite, 26, 32, 36.
  Braunkohle, 34.
  Braunspath, 82.
  Bredbergite, 104.
Breithauptite, 2.
  Breunerite, 84.
  Brittle silver ore, 18.
Brochantite, 52.
Bromargyrite, 48, 60.
Bromlite, 80.
  Bromsilber, 48, 60.
Bromyrite, 60.
  Bronzite, 86, 94.
Brookite, 92.
Brucite, 64.
  Buntbleierz, 76.
  Buntkupferkies, 2, 4.
  Bustamit, 94.

Cacoxenite, 44,
Calamine, 86.
  Calamite, 96.

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Calc Spar, 72.
Calcite, 72.
Calcium Felspar, 100.
Calcium Sodium Felsp., 98.
Caledonite, 72.
Callaite, 96.
Calomel, 60.
Caporcianite, 78.
Carbunculus, 104.
Carnallite, 70.
Carpholite, 88.
Cassiterite, 36, 46, 102.
Celestite, 74.
Cerargyrite, 60.
Cererit, 90.
Cerite, 90.
Cerussite, 78.
Chabazite, 86.
Chalcanthite, 66.
Chalcedony, 102.
Chalcocite, 16, 24.
Chalcophyllite, 50.
Chalcopyrite, 4.
Chamosit, 50.
Chiastolite, 94, 104.
Chili nitre, 60.
Chloantite, 10.
Chlorargyrite, 60.
Chlorbromsilber, 48.
Chlorite group, 50.
Chloritoid, 94.
Chloritspath, 94.
Chloropal, 32, 40, 48.
Chlorspath, 72.
Chondrodite, 100.
Christianit, 88.
Chromeisenerz, 26.
Chromite, 26.
Chrysoberyl, 106.
Chrysocolla, 34, 38, 52, 56, 78.
Chrysolite, 102.
Chrysotile, 62, 78.
Cinnabar, 36.
Clausthalite, 16.
Cleavelandite, 98.
Clinoclasite, 50.
Cobaltite, 10.
Cölestin, 74.
Columbite, 28, 32, 38.
Common salt, 68.
Comptonit, 92.
Copalite, 62.
Copiapite, 40.
Copper, 2.
Copperas, 62.
Copper Pyrites, 4.
Cordierite, 104.
Corundum, 106.
Covellite, 30.
Crocoite, 42.
Cronstedtite, 50.
Cryolite, 76.
Cupreous Hydrozincite, 64.
Cuprite, 38.
Cyanite, 94.
Datolite, 88.
Descloizite, 78.
Desmin, 78.
Deweylite, 70.
Diadochite, 44.
Dialogit, 84.
Diamond, 106.
Diaphorite, 14.
Diaspore, 96.
Dichroite, 104.
Diopside, 96.
Dioptase, 54, 56.
Disthene, 94.
Dolomite, 82.
Domeykite, 8.
Dufrenite, 50.
Dufrenoysite, 18.
Dunkles Rothgiltigerz, 38.
Dyscrasite, 8.

Edelite, 100.
Ehlite, 48.
Eisenglanz, 22, 38.
Eisenkies, 6.
Eisensinter, 80.
Eisenspath, 34.
Eisen Spath, 84.
Ekebergite, 94.
Elaeolite, 98.
Electrum, 4.
Embolite, 48, 60.
Emerald, 106.
Emerald Nickel, 52.
Emplectite, 14.
Enargite, 24, 30.
Enstatite, 86, 94.
Epidote, 100.
Epsomite, 66.
Erdkobalt, 30.
Erdöl, 58.
Erdpech, 30, 34.
Erdwachs, 32.
Erubescite, 2, 4.
Erythrite, 36.
Euchroite, 50.
Eugenglanz, 24.
Eulytite, 86.
Exanthalit, 62.

Fassaite, 88, 96.
Federerz, 14.
Feldspar group, 92.
Fettbol, 32.
Feuerblende, 36.
Fibrolite, 102.
Fischaugenstein, 86.
Flint, 102.
Fluorite, 82.
Fowlerite, 94.
Franklinite, 28.
Freieslebenite, 14.

Galenite, 16.
Galmei, 84, 86.
Garnet, 104.
Garnierite, 48.
Gehlenite, 92.
Gelbbleierz, 72.
Gelbeisenerz, 44.
Gelbnickelkies, 4.
Genthite, 48.
Gersdorffite, 10, 20.
Glauberite, 70.
Glauber's salt, 62.
Gold, 4.
Goslarite, 66.
Göthite, 34, 46.
Gramenite, 32, 40.
Grammatite, 96.
Granatite, 104.
Graphite, 22.
Graunickelkies, 10, 20.
Grauspiessglaserz, 14.
Green Augite, 88.
Greenockite, 44.
Greenovite, 94.
Green stone, 62.
Green vitriol, 62.
Groroilith, 32.
Grossularite, 104.
Grünbleierz, 76.
Grüneisenerz, 50.
Gummierz, 42.
Gummite, 42.
Gymnit, 70.
Gypsum, 62.

Haarkies, 4.
Haarsalz, 64.
Halite, 68.
Halloysite, 62.
Halochalzit, 52.
Harmotome, 88.
Hartmanganerz, 32, 36.
Hauerite, 38.
Hausmannite, 26.
Haüynite, 88.
Heavy Spar, 74.
Hedenbergite, 90.
Helvin, 96.
Helvite, 96.
Hematite, 22, 28, 38.
Hemimorphite, 86.
Hermesite, 20.
Herrengrundite, 56.
Hessite, 8.
Heulandite, 78.
Hiddenite, 98.
Hohlspath, 94.
Hönigstein, 70.
Hornblende, 54.
Hornsilver, 60.
Hübnerite, 34.
Humboldtine, 40.
Humboldtite, 88.
Humite, 100.
Hyacinth, 106.
Hyalite, 96.
Hydrargyrite, 76.
Hydrozincite, 70.

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Hypersthene, 98.
Hyposklerit, 98.

Iceland Spar, 72.
Ichthyopthalmit, 86.
Idocrase, 102.
Ilmenite, 26.
Ilmenorutile, 102.
Ilvaite, 32.
Ilvait, 54.
Indianite, 100.
Iodsilber, 40.
Iodyrite, 40.
Iolite, 104.
Iridosmine, 12.
Iron, 22.
Iron-lime Pyroxene, 90.
Iron Pyrites, 6.
Iron vitriol, 62.

Jacksonite, 100.
Jade (Nephrite), 98.
Jamesonite, 14.
Jarosite, 44.

Kainite, 68.
Kaliglimmer, 68.
Kalinite, 62.
Kalkglimmer, 84.
Kalkharmotom, 88.
Kalkuranit, 42.
Kalkvolborthite, 42.
Kallait, 96.
Kallochrom, 42.
Kammkies, 6.
Kampylit, 78.
Kaolinite, 58.
Karstenit, 74.
Keramohalite, 64.
Kermesite, 36.
Kiesel, 102.
Kieselkupfer, 34, 38.
Kieselkupfererz, 52. 78.
Kieselmanganerz, 94.
Kieselwismuth, 86.
Kieselzinkerz, 86.
Kieserite, 76.
Kieserit, 76.
Klinochlor, 68.
Kobaltblüthe, 36.
Kobaltglanz, 10.
Kobaltin, 10.
Kobaltkies, 10.
Kobaltvitriol, 68.
Kongsbergite, 8.
Kraurite, 50.
Kreuzstein, 88.
Kryolith, 76.
Kupferglanz, 16, 24.
Kupferglimmer, 50.
Kupferindig, 30.
Kupferkies, 4.
Kuferlasur, 56.
Kupferschaum, 50, 54.
Kupfersmaragd, 54, 56.
Kupferuranit, 40, 48.
Kupfervitriol, 66.
Kupferwismuthglanz, 14.

Labradorite, 100.
Lanthanocerit, 90.
Lapis Lazuli, 56.
Lasurite, 56.
Lasurstein, 56.
Laumontite, 78.
Lazulite, 90.
Leadhillite, 72.
Lederite, 94.
Lepidocrocite, 34.
Lepidolite, 70.
Leucite, 96.
Leucocyclite, 86.
Libethenite, 52.
Lichtes Rothgiltigerz, 38.
Lievrite, 32.
Lievrite, 54.
Lignite, 34.
Ligurite, 94.
Limonite, 34, 46.
Linarite, 56.
Linnaeite, 10.
Linseners, 50, 56.
Lintonite, 92.
Liroconite, 50, 56.
Lithionglimmer, 70.
Lithionit, 70.
Löllingite, 10.

Magnesiaglimmer, 66.
Magnesite, 84.
Magneteisenerz, 26.
Magnetite, 26.
Magnetkies, 6.
Malachite, 52, 54.
Malakolith, 96.
Malthazite, 60.
Manganblende, 26, 52.
Manganite, 20, 26.
Mangankies, 38.
Manganocalcit, 84.
Manganschaum, 32.
Manganspath, 84.
Marcasite, 6.
Marcellin, 26, 32, 36.
Margarite, 84.
Meerschaum, 64.
Meionit, 94.
Melaconite, 26.
Melanglanz, 18, 24.
Melanterite, 62.
Mellite, 70.
Menaccanite, 26.
Mendipite, 72.
Mennige, 42.
Mercury, 6.
Mesotype, 88.
Messingblüthe, 64.
Meteoric Iron, 22.
Miargyrite, 20, 24.
Millerite, 4.
Mimetesit, 78.
Mimetite, 78
Mineral wax, 58.
Minium, 42.
Mirabilite, 62.
Mispickel, 10.
Misy, 40.
Mixonit, 94.
Molybdänglanz, 12.
Molybdenite, 12.
Montebrasit, 90.
Montmorillonit, 60.
Moonstone, 98.
Morvenit, 88.
Mundic, 6.
Muscovite, 68.

Nacrite, 58.
Nadeleisenerz, 46.
Nadelzeolith, 88.
Nagyagite, 12, 22.
Natrolite, 88.
Natron, 64.
Natronsalpeter, 60.
Nephelin, 98.
Nephelite, 98.
Nephrite (or Jade), 96.
Newjanskite, 12.
Niccolite, 2.
Nickelblüthe, 48, 66.
Nickelin, 2.
Nickel Sepiolith, 48.
Nickel Smaragd, 52.
Niobit, 32.
Niobite, 28, 38.
Nitre, 62.
Nontronit, 32.
Nontronite, 40, 48.
Nosean, 92.
Nosite, 92.
Numäit, 48.

Obsidian, 102.
Ochroit, 90.
Octahedrite, 98.
Oligoclase, 98.
Olivenite, 52.
Olivine, 102.
Omphacite, 96.
Opal, 90.
Ophite, 78.
Orpiment, 40.
Orthite, 100.
Orthoclase, 98.
Oxalite, 40.
Oxhaverite, 86.
Ozocerite, 32, 58.

Paisbergit, 94.
Parasit, 104.
Paulit, 98.
Pechstein, 90.
Peganite, 76.
Pegmatit, 98.

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Peridot, 102.
Periklin, 98.
Perl Glimmer, 84.
Perlite, 90.
Perlstein, 90.
Perofskite, 92.
Perowskite, 92.
Petroleum, 58.
Phakolith, 86.
Pharmacolite, 66.
Pharmacosiderite, 42.
Pharmakochalzit, 52.
Pharmakopyrite, 10.
Phasalite, 106.
Phillipsite, 88.
Phlogopite, 70.
Phosgenite, 72.
Phosphorchalcit, 54.
Phosphoreisensinter, 44.
Picotite, 106.
Picrolite, 78, 82.
Pictite, 94.
Pinguite, 32, 40, 48.
Pistacite, 100.
Pistomesite, 84.
Pitchstone, 90.
Pitticite, 42.
Platinum, 22.
Plattnerite, 34.
Pleonast, 54.
Polianite, 22.
Polybasite, 24.
Polyhalite, 74.
Porcelain earth, 58.
Porzellanit, 94.
Potash Alum, 62.
Potash Mica, 68.
Potassium Feldspar, 98.
Prasin, 48, 52.
Prehnite, 100.
Protobastit, 94.
Proustite, 38.
Psilomelane, 32, 36.
Pucherite, 44.
Pycnite, 106.
Pyrargyrite, 38.
Pyrgom, 88.
Pyrichrotit, 36.
Pyrite, 6.
Pyrolusite, 12, 24.
Pyrolusite, 22.
Pyromorphite, 76.
Pyrope, 104.
Pyrophasalite, 106.
Pyrophyllite, 60.
Pyrrhotin, 6.
Pyrrhotite, 6.
Pyrostibite, 36.
Pyrostilpnite, 36.
Pyroxene, 54, 88, 96, 98.

Quartz, 46, 102.
Quartz (Varieties), 102.
Quecksilberfahlerz, 20.
Quecksilberhornerz, 60.
Rädelerz, 18.
Realgar, 40.
Resinit, 90.
Retinite, 62.
Rhäticit, 94.
Rhetinit, 62.
Rhodochrosite, 84.
Rhodonite, 94.
Rhombischer Vanadit, 78.
Riemannit, 76.
Ripidolite, 68.
Rose spar, 84.
Rothbleierz, 42.
Rotheisenerz, 22, 38.
Rothgiltigerz (dunkles), 38.
Rothgiltigerz (lichtes), 38.
Rothkupfererz, 38.
Rothnickelkies, 2.
Rothspiessglanzerz, 36.
Rothspiessglaserz, 36.
Rothzinkerz, 38, 46.
Ruby, 106.
Rutile, 22, 28, 36, 46, 102.

Sahlite, 96.
Sal Ammoniac, 60.
Salmiak, 60.
Saltpeter, 62.
Sanidin, 98.
Sapphire, 106.
Sartorite, 20.
Sassolite, 60.
Saussurite, 100.
Scapolite, 94.
Scheelbeierz, 72.
Scheelite, 86.
Scheelspath, 86.
Schilfglaserz, 14.
Schörl, 104.
Schrifterz, 12.
Schwefelkies, 6.
Schwerbleierz, 34.
Schwerspath, 74.
Scleroclase, 20.
Scorodite, 80.
Selenblei, 16.
Selenquecksilber, 18.
Séméline, 94.
Senarmontite, 66.
Sepiolite, 64.
Serpentine, 62, 78, 82.
Siderite, 34, 84.
Silberantimonglanz, 20.
Silberhornerz, 60.
Silberkies, 4.
Silberkupferglanz, 24.
Silex, 102.
Sillimanite, 102.
Silver, 8.
Sisserskite, 12.
Skolecit, 88.
Skutterudite, 12.
Smaltin, 22.
Smaltite, 10, 22.
Smectite, 60.
Smithsonite, 84.
Sodalite, 92.
Soda Nitre, 60.
Sodium Felspar, 98.
Sodium-calcium Fels., 100.
Spatheisenstein, 84.
Spathic Iron, 84.
Specularite, 22, 28.
Speerkies, 6.
Speiskobalt, 22.
Spessartite, 104.
Sphalerite, 30, 34, 44, 82.
Sphene, 94.
Spinel, 54, 106.
Spinthère, 94.
Spodumene, 98.
Sprödglaserz, 24.
Stannin, 20.
Stannite, 20.
Stasfurtit, 104.
Staurolite, 104.
Staurotide, 104.
Steatite, 58.
Steinöl, 58.
Steinsalz, 68.
Stephanite, 18, 24.
Sternbergite, 4.
Stibnite, 14.
Stilbite, 78.
Stolzite, 72.
Strahlenblende, 44.
Strahlerz, 50.
Striegisan, 76.
Stromeyerite, 24.
Strontianite, 80.
Succinite, 68.
Sulphur, 42, 64.
Sunstone, 98.
Sylvanite, 6, 12.
Sylvin, 68.
Sylvite, 68.

Talc, 58.
Talkspath, 84.
Tellurblei, 8,
Tellurium, 6.
Tellursilber, 8.
Tellursilberglanz, 8.
Tellurwismuth, 14.
Tennantite, 20.
Tenorite, 26.
Tephroite, 94.
Tesselite, 86.
Tesseralkies, 12.
Tetradymite, 14.
Tetrahedrite, 20, 26.
Thomsonite, 92.
Thumite, 104.
Tiemannite, 18.
Tinkal, 64.
Titaneisenerz, 26.
Titanite, 94.
Topaz, 106.
Topazius, 106.
Torbernite, 40, 48.

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Tourmaline, 104.
Tremolite, 96.
Triphan, 98.
Triphylin, 82.
Triphylite, 82.
Triplite, 46, 86.
Trona, 64.
Tschermigite, 64.
Turquois, 96.
Tyrolite, 50, 54.

Ulexite, 58.
Ullmannite, 10.
Uranglimmer, 40.
Urangummierz, 42.
Uraninite, 32.
Uranit, 42.
Uranogummit, 42.
Uranpecherz, 32.
Urao, 64.
Urvölgyite, 56.
Uwarowit, 104.

Valentinite, 68.
Vanadinbleispath, 74.
Vanadinite, 44, 74.
Vanadinspath, 74.
Vesuvianite, 102.
Vitriolbleierz, 74.
Vivianite, 54, 66.
Volborthite, 42.
Volcanic Glass, 102.

Wad, 32.
Wagnerite, 90.
Wavellite, 76.
Weichmanganerz, 12, 24.
Weissbleierz, 78.
Weissnickelkies, 10.
Weisspiessglaserz, 68.
Wernerite, 90, 94.
White vitriol, 66.
Willemite, 92.
Wismuthglanz, 16.
Witherite, 80.
Witmuthocher, 82.
Wittichenite, 18, 24.
Wolframite, 34.
Wollastonite, 86.
Wulfenite, 72.
Würfelerz, 42.
Wurtzite, 44.

Xanthoconite, 42.
Xylochlor, 86.

Zaratite, 52.
Zinc Blende, 44, 82.
Zincite, 38, 46.
Zinckenite, 16.
Zinkblende, 30.
Zinkblüthe, 70.
Zinkspath, 84.
Zinkvitriol, 66.
Zinnerz, 36, 46, 102.
Zinnkies, 20.
Zinnober, 36.
Zinnstein, 102.
Zircon, 106.
Zoisite, 100.

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